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AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

JULY 1928

The Ascendency of Applied Science in Agriculture - - - - - - - *O. B. Zimmerman*

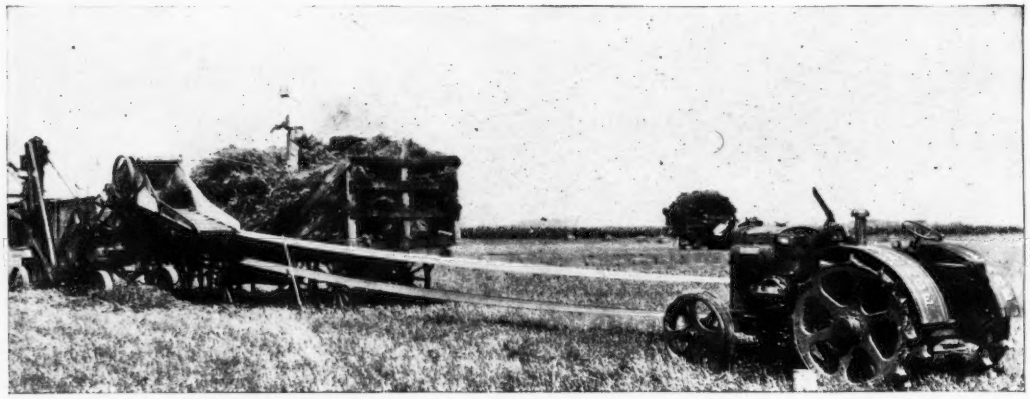
Organization for Rural Electric Development - - - - - - - - - *G. C. Neff*

Survey of Soybean Harvesting Methods in Virginia - - - - - - - - *D. C. Heitshu*

A Study of Spring Overload Release Hitches - - - - - - - - - *E. G. McKibben*

Lighting Farm Buildings by Calcium Carbide Gas - - - - - - *Clara Woolworth*

Results of Pennsylvania Power and Labor Studies - - - - - - *H. B. Josephson*



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WILLIAM BOSS, President — RAYMOND OLNEY, Secretary-Treasurer

Vol. 9 — JULY, 1928 — No. 7

CONTENTS

THE ASCENDENCY OF APPLIED SCIENCE IN THE INDUSTRY OF AGRICULTURE 201
By O. B. Zimmerman

THE ORGANIZATION OF AN ELECTRIC LIGHT AND POWER COMPANY FOR RURAL DEVELOPMENT 206
By G. C. Neff

SOYBEAN HARVESTING METHODS IN VIRGINIA 209
By D. C. Heitshu

SUBSTITUTES FOR BREAKPINS—SPRING OVERLOAD RELEASE HITCHES 215
By E. G. McKibben

LIGHTING FARM BUILDINGS WITH CARBIDE GAS 217
By Clara Woolworth

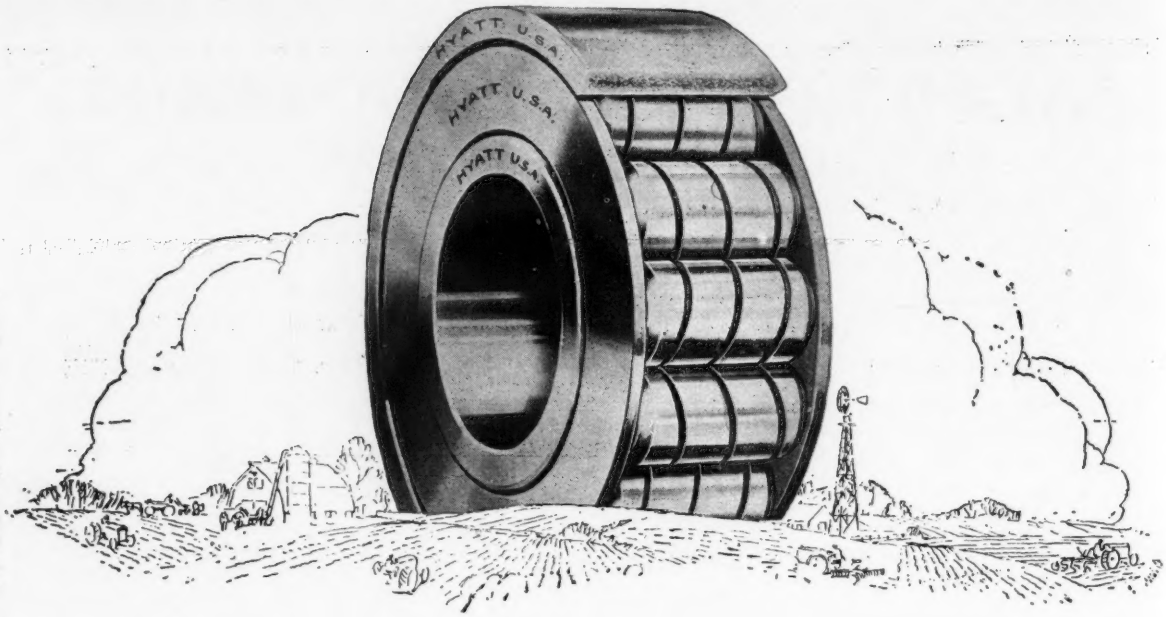
POWER AND LABOR STUDIES IN PENNSYLVANIA 219
By H. B. Josephson

AGRICULTURAL ENGINEERING DIGEST 224

EDITORIALS 226

WHO'S WHO IN AGRICULTURAL ENGINEERING 227

A.S.A.E. AND RELATED ACTIVITIES 229



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AGRICULTURAL ENGINEERING

Vol. 9 JULY, 1928 No. 7

The Ascendency of Applied Science in the Industry of Agriculture[1]

By O. B. Zimmerman[2]

THERE is a special significance in the fact that this twenty-second annual meeting of The American Society of Agricultural Engineers is being held in Washington. This city is not only our national capital, but is also our scientific capital. From its public and private groups and leaders, there flows to the country a constant stream of energizing information and influence. Here on every hand we find scientists and experts quietly operating or directing work along their several lines. They are unceasing in their efforts to discover, develop, and later to disseminate new truths for the betterment and welfare of our citizens. It is with this thought and in this spirit that we come to pay them our respects and offer them our whole-hearted cooperation and support in those constructive efforts.

While our major interest here is naturally in the United States Department of Agriculture, we are also vitally interested in all of Washington's other departments and places of scientific research. It is a distinct privilege for us to come here as a society, as this visit will permit us to observe at first hand some of the newest developments and thus enable us better to anticipate practical applications and requirements from the engineering point of view.

Again we purpose to benefit through a better knowledge of the personnel in the various departments, their surroundings, working conditions and problems. From such a review one outstanding deduction cannot fail to impress us profoundly—a deduction which may be expressed in a few words as "The Ascendency of Applied Science."

America's collective attention is now focused as never before on agriculture and its problems in their relation to the national welfare. It is a vast subject in its size, its diversity and its potentialities. Every angle of it is worthy of our special attention. It is but natural, then, that a fit subject for review on this occasion should be agricultural progress, in which program the function of the engineer becomes more and more conspicuous.

I wonder whether it has fully dawned on us as engineers—and certainly it is less apparent to the individual agriculturist—just what is taking place in this complex development in which we have a part and why. Again I say I believe that this point can be covered in a few words. I believe that under powerful economic pressure the great basic industry of agriculture, always ultra-conservative, is finally swinging into line with other industries in recognition of the value of applied science.

The old ways and means of agriculture are giving place to the new. While this change has been anticipated and has been under way in no small degree for years, it has come upon us from so many angles and so quickly that no one can predict where it will lead or force us. Agriculture is having a host of new problems presented to it similar to those met by other businesses and industries in the past. We are sure that no one will deny that the safest guiding influence will be more and more the practical use of the sciences in their relation to our agricultural problems, including both production and marketing. This is the influence that has solved or is solving the problems of other industries of less magnitude and of greater simplicity than agriculture. Every such development has had its period of intense unrest, due to a breakdown of the old ways, and its period of uncertainty, but wherever the light of science has been recognized and sensibly used, reorganization has followed, with resulting stability and prosperity.

The trend of all industry is from the simple to the complex, from the empirical to the scientific. Up to less than

[1]The president's annual address before the 22nd annual meeting of the American Society of Agricultural Engineers at Washington, D. C., June, 1928.

[2]Assistant to manager, engineering department, International Harvester Co. Junior past-president, American Society of Agricultural Engineers. Mem. A.S.A.E.



Farmers everywhere are turning away from the slow, expensive methods of horse and wagon hauling, to the faster, cheaper and more comfortable motor truck equipped with special grain tank body



In the great western grain fields it is common practice to store the wheat in portable field bins. Here is Fred Rogerson of Kelfield, Saskatchewan, transferring direct, thus saving time and expense

fifty years ago human progress was limited by custom, tradition and rule-of-thumb guidance. Discovery and improvement were chiefly made by trial and error. Often stumbling observations and accidents led the way to results. The better accomplishments were copied and modified by others who added fuel to the fire of progress. The less ingenious in the machinery field imitated the originators as far as patent rights permitted, and the more ingenious took the suggestions and evolved superior products.

Under this procedure history was filled with the names of individuals known to the public as geniuses—and geniuses they truly were, because they were thinking ahead of their times, striving to attain ends with little to guide them, and lacking the means and facilities, the collected and digested data of today.

Empirical development still prevails for a period in all the newer developments, but that period grows shorter and shorter as the fundamentals of the underlying science become better known. Such development has its rightful place, its logical place; it is to be expected and respected. But when reliable scientific information is available to lead us rapidly to a desired end, we should use it, and we are using it.

The time was when it was popular to poke fun at those who displayed even a slight knowledge of science or its application. This has so changed that industry now invites and welcomes all such expressions. Progressive industry today seeks to apply intelligently all scientific information and deductions. One needs but to review the progress of a few of the older industries to see how rapidly progress has followed upon the adoption of modern methods.

Take, for example, the leather industry, operating as it does upon a product of agriculture. From the earliest times leather has been used by man—but for ages it was cured solely by smoke-tanning. Our own American Indians improved tanning practice to a point where they were using buffalo dung, oil, clay and sour milk. Vegetable tanning processes were introduced in relatively modern times and were improved until depletion in tannic acid sources enforced research for quantity substitutes. Thus came into that industry the more extended employment of chemists who developed the more general use of chemicals, lime, alum, chromium compounds, etc., in their purer forms. Today the leather industry has given up the empirical methods almost completely, in favor of the more up-to-date scientific methods with their marked improvements in quality, uniformity, variety and beauty.

Cheese making was for untold generations an empirical process, a rule-of-thumb procedure surrounded by family secrets. In the well-known varieties local conditions and influences created desirable characteristics in the product, the causes of which were rarely known even to the experts. Following the comparatively recent discovery of the control factors by the chemist and the zymologist, these products are now being made better and more certain in value. The production hazard has been greatly reduced, the processing time has been cut down, and uniform quality, greater preservability, and lower costs have resulted.

Meats, smoked, dried, salted, pickled, in the crudest and often almost unpalatable forms, served man's needs down into the last century when applied science lent a hand. The meat packers not only improved and regularized both processes and products, but they also brought to world attention the importance of utilizing former wastes. As is well known, they learned how to save practically everything out of the carcass and found a ready market for it. Applied science solved the many problems of meat packing and besides provided us with incomparably better meats than previous generations had known.

Sugar cane, starting from its cradle in India over two thousand years ago, spread slowly throughout the world's inhabited areas. Sucking the sweetness from sections of cane stalks was the uniform means of enjoying sugar up to three hundred years ago when the crystallizing processes became better known. A century ago granulated sugar was not on the market in any great quantity nor of any such quality as today. Sugar cane was propagated up to forty years ago by cuttings. There was little control over plant improvement until certain plant breeders finally found a successful means of propagation by seed. Then followed marked improvement in cane yield per acre and in percentage of sugar content in the cane.

The story of the sugar beet likewise is one of many generations of almost unchanged empirical procedure, and then of rapid development when careful analysis of product, selection of seed, and plant breeding took effect.

Lately a new source of sugar has been opened up—the artichoke which, in its various forms, through studies here at the Bureau of Plant Industry and the Bureau of Standards, attracts our wondering attention by its possibilities. Levulose sugar, long resistant to cheap crystallization, is now proved by careful research to be a commercial possibility. The indications are that this product, under highly developed modern methods, will become a logical farm product in all suitable areas.

Electrical phenomena, observed in their simplest forms two thousand five hundred years ago, remained in that stage until two hundred years ago. Bits of information were gathered here and there during that interval, but they were more entertaining than useful. Several experimenters have their names recorded in history as the result of their findings, but not until the end of the last century did any marked practical advance occur. Progress came only when a sufficient number of facts became known to establish laws and make them available as an applied science. How fast

electricity then came into almost every phase of human activity is known to all of us. Electricity's application to agriculture is only now beginning. What form this activity will eventually take cannot now be predicted.

The story of steel, likewise, is one of slow empirical development for centuries, and then of almost miraculous development in modern times—chiefly a miracle of applied science. At home I have an interesting example of primitive steel-working—a large and wicked-looking Russian knife made in comparatively recent times but by the processes of long ago. It was fashioned by a native expert in the wilds of the Caucasus from local ore which he doubtless reduced in a crucible with charcoal. In its rough finished form it was buried in the dark of the moon in a secret spot and covered with a special clay, and there lay seasoning for two full years, each step of the process being accompanied by prayers, incantations and mystic rites. When it was fully fashioned it had still to undergo the blood test —that is, it must prove its edge and temper by cutting a sheep in two at a single powerful blow.

We smile at such primitiveness, yet we should remember that hardly more than a century ago and in the most highly civilized countries steel making was hedged about by mysteries and secrecies, and that fine crucible steels brought prices that now seem fabulous. The history of iron is thousands of years old and the story of steel goes back hundreds of years, but it was not until the nineteenth century brought the world a Bessemer that steel began to be plentiful and cheap through the application of science to all the phases of its production. Let us remember, too, that alloy steels as such, so extensively used today, are strictly a product of this century. Our knowledge of this promising phase of metallurgy is scarcely twenty-five years old.

Of outstanding interest to agriculture is the investigation covering the processing of metals to make the product more resistant to corrosion. Another inquiry is aimed to develop material with great strength under relatively high temperatures.

New problems in the processing of metals are constantly being called to our attention. Developments including carburizing, case hardening, nitriding and many of the more conventional hardening and drawing operations. Problems in metal formation and deformation, casting, chilling, drawing, extruding, forging both cold and hot, are numerous. Such problems are ever being more skillfully and economically met.

Metal coating by means of paints, varnishes, lacquers, japans, coating with metals, galvanizing, sherardizing, parkerizing, and plating with nickel, cadmium and chromium are being rapidly improved. These are but indications of the results attained by serious research which will make for better products, and which will reduce waste and costs.

The old time farm tools and machines which could be fashioned in the country blacksmith shop are no more. They were made with simple hand tools—a forge, an anvil, a post drill, sets of hand taps and dies—and perhaps a small lathe. Available materials were of a minimum variety and quality. The blacksmith had only a few wooden shapes and his iron was in rounds, flats, boiler plate and sheets. His heat-treating equipment was a quenching tub of water, and a box of lime was his annealing oven. His eye and judgment were the only pyrometer to guide his heat treatments.

Alongside of this picture see the modern manufacturing facilities—a long range of graded materials in a wide variation of shapes and sizes; the finest of machine tools and heat-treating equipment, operated by experts or directed by skilled help; orderly shop arrangements which provide marvelous. high-speed processing and assembly. Let us be reminded that these developments are very largely the results of but one brief generation of progress under the guidance of science.

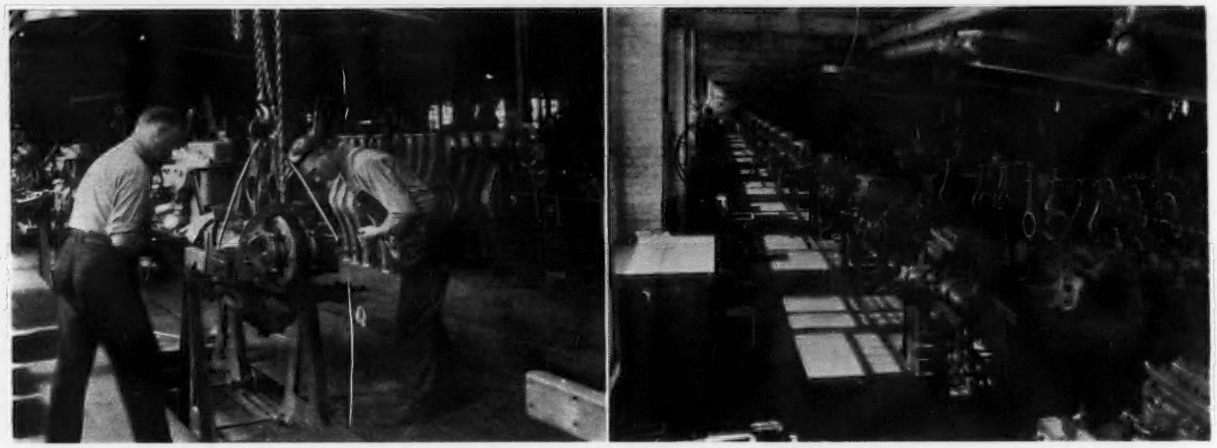
When we review the agricultural plant and note the part played by the various farm structures and see that the average value of the buildings runs from one-fifth to one-third of the total farm investment, it must occur to us that here is an important part in the engineering program, one which has not been as fully analyzed as it deserves. The variety of ideal requirements is great, since these buildings must serve the purposes of shelter for cattle, horses, sheep, hogs, poultry, and for needed feed supplies, for the temporary storage of various crops and for a number of special requirements, all under varying conditions of climate, etc.

The rude structures formerly supplying these needs are now seen to be utterly inadequate. Today's problems in farm structures cover ventilation, heating, sanitation, arrangement, convenience for both man and animals. This phase of the program invites us as engineers into many investigations aimed to decrease waste and raise efficiencies. Such primitive structural materials as sod, plastered mud and straw, thatched roofs, and boarded sides, are vanishing. The old buggy shed, which served the added purpose of a hen roost, did not encourage the production of hens with records of two hundred or more eggs yer pear. The old types of cow barn never could have produced at best the equal of the record cows of today nor of the horses fed and cared for by modern methods.

Another influence of applied science for the general good should be recorded because it affects all industry; that is, the movement toward simplification, standardization and specification. Perhaps the value of these things has not



A 10-20 tractor working at night to speed up disking. The practice of equipping tractors with lights and working them night and day is becoming rather commonplace. When a man works his tractor on night shifts he doubles the output of his equipment. Initial investment in machinery is thereby reduced. Charges for depreciation are also decreased



Progressive assembly is now a factor in every high speed production problem. (Left) From the transmission assembly and testing line the transmission and differential assemblies are next placed in tractor frame on the main assembly chain. Note the rear axle housings (background, right) ready to be placed in position on the moving tractors. (Right) A view of the tractor assembly chain indicating how the tractor is gradually built up. First the motor, then the radiator (on platform in front), then the fuel tank, transmission, and differential and rear axle housings are added

particularly appealed to agriculture, but they are of distinct benefit to the farmer through the improvements they bring about in the machines he uses.

The designer confronting a problem of the manufacture of a series of parts with a volume of a hundred million pieces each per year must go into the minutest study of every detail involved in that part, and such study invariably produces marked economies. Needless varieties are readily shown to be a waste, and the inquiry should result in a few logical graded parts chosen in proper relation one to the other in place of an indiscriminate unrelated group.

Let us imagine for a moment the effect of reversal of this process. Let the great American railroads set up independently new standard widths of track, each differing slightly from the others, and provide equipment accordingly. While the system would work smoothly for each unit, what a tremendous slow-down and confusion would result in interline traffic! Let the telephone companies separate into numerous smaller units and let each develop independent equipment and procedure to suit its own fancy; what a slow-down in transmission would result!

Without uniform weights and measures, credit system, banking practice, terminology and so on, what could we have but chaos? Yet, although we acknowledge the value of standardization, we go on operating blindly without it in situations where standardization is perfectly logical.

Take, for example, the design features involved in a set of screwed parts which should go together. Threads and nuts have been in general use for centuries, and they form important parts of every machine or device, yet not until the World War was there any rational national effort to coordinate the multitude of problems involved. Anyone familiar with this subject will testify to the potential value to American industry of the report in this connection made by the National Screw Thread Commission, the U. S. Bureau of Standards and the American Engineering Standards Committees. Group studies on screwed parts have been made in several manufacturing countries. Each of these was a helpful effort, but looked at internationally or even nationally, they missed the mark; even at best they are all amateur efforts alongside the report mentioned. And yet this fine work, available to everyone, has been utilized by only the more progressive of industries to date.

Agricultural equipment is full of design problems which, compared individually with major engineering structures or works, may seem to be small problems, but they are really of high and general importance. Engineers give the most careful consideration to engine details of a single 20,000-hp. machine; why not the same importance, or even more, to a thousand 20-hp. machines? There can be use for only a limited number of 20,000 hp. machines in the country, but the machine of 20 hp. or thereabouts must furnish the power for the motorized farm of smaller size—and more than half our farms in the United States are less than 100 acres.

Manifestly any real improvement in the agricultural situation must include improvement in the condition of those living on average and small-sized farms. To the vision of the engineer power farming must appeal as the most practical and immediate means of more economical and profitable farm operation—the logical place to begin cutting down farm production costs.

In available farm power we have seen marked improvement in the change from old Dobbin to the dependable and versatile tractor. This change has effected a noticeable speeding up of farm work, a marked reduction of labor hours, and increase of per man production. There has also been a marked increase in practical power applications. Rapid automobile and truck transport has become a necessary part of every progressive farm. Machinery has advanced from small capacity units to larger and faster machines, and there has been constant improvement in quality of work and the efficiency of the machinery. Areas operated per individual have grown from a few score to hundreds of acres. These advances have brought about reduction of man-hours, and hence of cost per unit of product.

Production per unit of area has been aided by applying the latest developments to the selection and use of fertilizer. Intensive farming, when done on a sound basis and by businesslike methods, is much more likely to be profitable than haphazard farming. Orderly marketing of produce by quality standards has shown also that it pays. High-producing and suitable animals, poultry, seeds, fruits are increasing in favor because they have proved their respective values.

All these changes, in one way or another, evidence the development of a higher commercial instinct in agriculture; they plainly show that the farmer is taking up and applying factors which insure greater earning power and greater stability. The utilization of more power, better machinery, an understanding of factors making for efficiency, the utilization of by-products, the elimination of waste have all become subjects of agricultural study.

At this point I wish to mention the unusually fine work carried on by our first vice-president, Mr. Arthur Huntington. He has attracted wide attention by his addresses before bankers' associations, chambers of commerce and other bodies, showing them the need and the value of their sympathetic interest and cooperation in solving the agricultural questions of the hour.

Farming has long been looked upon by layman and farmer alike largely as a series of mechanical processes covering the preparation of the soil, drainage, irrigation, cultivation, and harvesting. Prosperity of the individual farmer has been measured too largely by the area he operates rather than by the intensity of that operation.

Today we see more than ever that these activities involve to a high degree a wide variety of physical, chemical, botanical, biological, entomological, agronomic problems and processes, as well as problems and processes of engineering, all of which, properly handled, can add much to efficiency of agricultural production.

The old school farmer was content to produce the raw materials for foodstuffs and was little interested in their conversion and processing for consumption. The farmer of today realizes how much the packer, the miller and the other converters have done to develop both products and by-products from the raw output of the farm—from livestock, his cotton, grain, fruits, milk, beans, and so on. It is but natural that he should wish to have a larger earning part in what he raises. How can this desire be satisfied? Ventilation, curing, dehydration, preservation, refrigeration, fumigation, and the like, are more and more receiving his attention because they are means whereby direct spoilage can be reduced and marketing can be made more timely. Rust, insect life, fungus growths, he learns are controllable by poison sprays and dusts, thus reducing loss and rendering the grades of his products higher. The terms nitrogen, potassium, phosphorous, calcium begin to mean something real to him, as he learns that they effect the quantity and quality of his output. He, like all other industry, is learning the use of applied science.

In most of these problems the agricultural engineer is lending a hand, especially in that long-neglected field covering silt control and protection of the soil against loss of its valuable plant foods through erosion. And where else can the agriculturist look for guidance in solving his complex problems than to unprejudiced sources such as those offered by the United States Department of Agriculture, the agricultural college, the American Society of Agricultural Engineers, and to the industries that are based upon agriculture? These latter are spending millions yearly in the most constructive research and practical efforts to better all angles of development.

Much work is still to be done to coordinate all of these efforts. Take for example the silo, which fundamentally is a valuable food processing and preserving unit for the dairy. We are inclined to think that the mechanical problems of ensilage have been completely solved, but the biological, chemical and bacteriological problems involved are too complex for the comprehension of the mass of utilizers, many of whom fail to attain results at all comparable with the more skillfully operated silos. We need a most thorough research to ascertain more concerning the nature of these processes; to establish a better understanding by the layman of silo control, and still further reduce the labor required. Spoilage should thus be reduced and a wider application and confidence established in this farm unit. Whose job is this if it is not the agricultural engineer's?

A study of waste in agriculture is under way, but it is so far a mere beginning. This huge problem needs broad treatment as well as a minute analysis. Such a study has potential values to our nation far beyond any estimated costs. Mentioning only a few, we have wastes due to inadequate farm processing, storage management, grading, those caused by insect pests, plant diseases, and weeds, and those caused by inadequate dispersion of available information.

Only a few days ago we read in a bulletin from the United States Department of Agriculture the staggering statement that insect damage to our crops amounts to about two thousand million dollars a year and that the loss due to plant diseases runs into figures almost as great. What a challenge to the agricultural engineer that is, what a field of opportunity for the application of science in research and prevention!

Applied science has done much to reduce the labor and fatigue of farming and to take the hazard out of farm production; it has done much to make agriculture an occupation of profit and of contentment. No other country has supported its agricultural development in any measure comparable with ours. American agriculture as well as American manufacturing industry has attracted world-wide attention by its ability to produce cheaply and in abundance. Look about and note the number of the visiting commissions, committees, and delegations which come here from overseas endeavoring to find out the why of our unparalleled progress on our farms as well as in our factories.

Viewed in a broad way, it is important that this Society should further in every possible way the advancement of agricultural research. Budgets in the United States Department of Agriculture for this purpose are not adequate when measured up with requirements, and the budgets in the several agricultural colleges, as shown in the analysis of mechanical farm equipment research, are pitifully small. Investigators and educators both in number and quality can be and must be developed and equipped for the inevitably enlarging program of applied science in agriculture.

Making Labor Valuable

FOR countless centuries before the industrial revolution, in different lands and climates and among different races of men, the most common and, on the whole, the cheapest offering in the public market was labor. Human energy was plentiful but the knowledge of how to use it was scanty. The energy flowed freely enough, but the tools for converting it into practical results were crude and limited. Since the development and general use of power machinery, the value of human labor has increased. No period of increase has been more marked than that of the last quarter of a century in the United States.

The Commerce Yearbook for 1926 records the increased productivity per worker during the period from 1899 to 1925 to be 45 per cent in agriculture, 99 per cent in mining, and 48 per cent in manufacturing and railroad transportation. Discussing the major factors in this advance in industrial efficiency, the Monthly Labor Review touches on the contribution made by education, by the increased use of capital, improved machinery and power, mass production and the elimination of waste.

In manufacturing industries each wage earner, on the average, is aided by prime movers of a capacity of 4.3 hp., about double the amount in use in 1899. The railroad locomotive has doubled in capacity since 1900, but it is still operated by the same number of men.

Thus, by the education of the worker, by the study of the several tasks to be performed and the fitness of the worker for his task; by the development of new commodities, and, therefore, the discovery of new uses for human labor, and by the disposition of mechanical power as an aid subordinate to labor power, the results flowing from labor have been vastly increased. Labor has been made more valuable and in response to this increased value, the standard of living has materially increased. In America, where the diffusion of education and the use and disposition of mechanical power are widespread, labor enjoys its highest values and the standard of living is highest.

This achievement has been brought about by the cooperation and unstinting efforts of thousands of men. But notable in the contribution are the pioneers of invention, industrial organization and education. It is the work of individualists of high imaginative genius operating in an atmosphere of free institutions. These results are not the gift of bureaucracies or institutions for the purpose of establishing "standards of labor." The individualists who brought about these results have done it because they were men capable of great effort seeking great rewards, intellectual, moral and material. We speak of them as if in the past. They are with us today and will be tomorrow, as long as we protect the freedom of opportunity, the right to try.—Reprinted from "Law and Labor."

The Organization of an Electric Light and Power Company for Rural Development[1]

By G. C. Neff[2]

THE 1920 U. S. Census Report shows that nearly 50 per cent of the population of the United States lives in rural territory. About one-half of this rural population lives in communities of less than 2500 inhabitants and the other half lives on the farms. Rural electrification, therefore can be divided into two classes—rural community electrification and farm electrification.

Twenty years ago very few villages and country settlements had twenty-four-hour continuous electric service, and a great many of them had no electric service whatsoever. Some rural communities had electric service from dusk to midnight, others from dusk to dawn, and a few had service on Tuesdays to permit the housewife to use an electric iron during the day.

As electric service began to assume more and more importance in the home and factory, the people in rural communities asked for better service, and as a result leaders of electric light and power companies undertook to supply it. They knew of the benefits continuous electric service had brought to the city and they felt confident that the same benefits would accrue to the smaller settlements in the country. The problems of supplying electric service to rural communities were quite different from those of supplying service in the larger cities. Many miles of transmission line had to be built to many small communities to reach the number of customers that in a single city could be reached by one distribution system. The cost of the facilities necessary to serve these widely scattered villages was, therefore, higher than in the larger cities. The utility organization was necessarily scattered into many groups, some of them hundreds of miles apart, and this introduced many new problems not found in urban utility organization. Twenty years ago many people in this country thought it highly impracticable to supply continuous electric service to these small rural communities. They considered such rural electrification a foolish venture. Nevertheless, men in control of light and power companies continued their progressive effort and organized investment companies and subsidiary operating companies for the distinct purpose of carrying big city service to rural communities. The rapid development of transmission line networks throughout the rural territory of this country shows how well and how thoroughly this work has been done.

Today there are many utility companies whose entire business consists of service to country settlements, villages, and small cities. Such a company may serve a territory extending over thousands of square miles and yet have fewer customers than a company which serves one city of 300,000. Until very recently, these rural utility companies have been very busy building transmission lines to connect widely scattered small communities so that they could be served as a unit from some one or two large efficient generating plants. While the electric load in each community was small, the combined load of many justified the building and operation of such plants where energy could be produced at low cost because it was made in large quantities. In this way each small community got the benefit of mass production of electrical energy. This development has made electric service available in nearly every village and hamlet and has brought it that much nearer to the farmers of this country.

While undoubtedly interested in the development just described, you are more interested in extending electric service to the farmer.

As a result of the very extensive experimental work done during the past four years by agricultural and public utility organizations, farm electrification has now reached the stage where the question of utility organization to carry on this work is an important one. No utility company operating in rural territory supplying electric service to the farmers therein can hope to be successful in this work unless those responsible for the operation of the company really believe that farm electrification can pay its own way, that there is a load on the farm sufficient in amount to justify the expenditure for the required distribution lines, that the farmers can afford to pay the necessary charges for this service, and that they can profit by its use. The executives must have confidence in farm electrification if much headway is to be

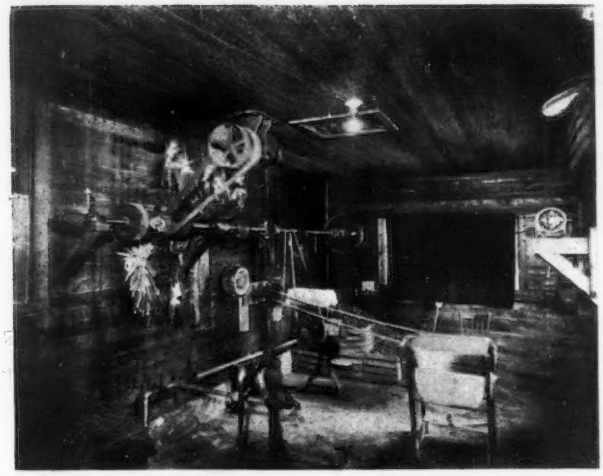
[1]A paper presented at the rural electric session of the 22nd annual meeting of the American Society of Agricultural Engineers, at Washington, D. C., June, 1928.

[2]Vice-president, Wisconsin Power and Light Co. Mem. A.S.A.E.

Farm Users of Electricity Need Help

The farm customers of the electric power companies need such help in the application of electric service as will result in the most profitable use of the service to themselves and to the power companies. It is the function of the rural service engineer to give his help to recommend equipment, and to act as consulting engineer on all questions relating to the application of electricity to requirements about the farm and in the farm home.





In the various applications of electricity to farm operations the help of a competent engineer is essential to the most efficient and otherwise satisfactory use of electric service. The power company's rural service engineer is the logical person to render such help

made in this development. If an executive believes in the permanence of this development and that general farm electrification is of benefit to both the utility and the farmers, his entire organization will soon begin to feel that same way. The farmers who deal with such an organization will soon recognize the sincerity of its aims. As a result, there is developed between the farmers in the territory and the people of the utility company a feeling of confidence which is very valuable and necessary to satisfactory farm electrification.

Important facts in this development that utility company executives should appreciate are that farm electrification is a big job, that it calls for the expenditure of large sums of money in distribution system, and that it offers a big opportunity to the utility company to increase its business. Because it is a big and important development, special consideration should be given to the utility organization.

If the executives of a utility company believe in farm electrification and realize its cost and possibilities, they are sure to adopt an extension policy under the operation of which the utility will bear the cost of the entire farm distribution system under average conditions.

They will also adopt a farm rate schedule especially designed to meet farm conditions and so constructed that the farm customer who uses only a little energy must pay a relatively high price for the service rendered, but not enough to make this low consumption profitable to the utility. In other words, farm electrification cannot be developed on a permanent basis if the average consumption per customer is low, and it is very desirable to bring this fact to the attention of both the farmer and the utility each month through the application of a proper rate schedule. Such a rate schedule will force both the farmer and the utility company to cooperate in building the farm load.

A most essential requirement for successful farm electrification is the full cooperation of the engineering department. In order that new construction may be adequate to meet the growing demands of farm electric service, it is necessary to establish certain standards. It is essential that the first cost of farm lines be low so that they may be extended to reach the greatest possible number of farmers. However, the cost must be sufficient to provide durable and efficient lines in order that they will withstand storms, carry maximum loads and maintain satisfactory voltage. Farm service can be furnished over such lines with a minimum of maintenance and operating expense.

This is distinctly an engineering problem and offers the engineer his opportunity and responsibility to advance farm electrification.

If a utility company serves 200 small cities and villages in an area of 10,000 square miles, for example, it is obvious that its operating organization would necessarily consist of groups located at suitable points in the territory served but all coordinated by some central organization. Such a company might have its territory divided into perhaps three divisions, each under the supervision of a division manager. The territory served by each division, being too large for efficient direct operation, would logically be subdivided into districts. Let us assume an average of six districts in a division, each supervised by a district manager. Under such conditions, the company's activities in the 10,000 square mile area would be carried on by eighteen district organizations supervised by eighteen district managers reporting to three division managers who, in turn, would report to the general manager or operating head. The actual organization will vary in each company, but the above organization plan is typical. In a 10,000 square mile area there may be 40,000 farms scattered throughout the several districts. The farmers will naturally look to the district offices for information on how to get electric service to their farms. To give them proper attention, someone in the district office must understand and have the time to talk intelligently about farm electrification. This requires at least one farm service man in each district office. Such a man should, in my opinion, be agriculturally rather than electrically trained, for there is plenty of electrical talent in the district office, but very little knowledge of farm problems. If the district farm service man has had agricultural training, he is able to discuss intelligently the farmer's problems. Agricultural engineers, if they have the necessary personal qualifications, make ideal men for this work. It cannot be expected, of course, that a young man just graduated from college, who has had no utility training and experience, can take a position of this kind until after he has been with a utility company for a reasonable length of time and has become familiar with the fundamentals of the utility business. These he can learn sufficiently in a period of six months to fit him for the work. The duty of the farm service man is to take charge of and guide the farm electric development in the district in which he is located. This, of course, does not mean he should be given a free hand to do whatever he pleases, but it does mean he should be given as much responsibility as he can carry and that he be permitted to devote his time and attention to farm electrification. He should meet with farmers who are considering electric service for their farms and explain to them fully the extension policy of the utility company, the rates charged for service, and anything else that the farmers want to know concerning electrification of their farms. He should meet with all farm customers to help them use electric service more profitably. He should be in a position to recommend the kind of equipment to use and the kind not to use so that the best results can be obtained. He should be competent to act as a consulting engineer for the farmers on all questions relating to the application of electricity to farm operations. He should take the initiative and call on the farm customers at regular intervals so that all of these problems can be intelligently discussed.

He should make use of Bulletin No. 4 of the Committee on the Relation of Electricity to Agriculture, for in this bulletin he has a guide which is authentic, up to date, and rather complete. Many companies are giving one of these bulletins to each of their farm customers with very satisfactory results. The farmers appear to be very much interested in this bulletin and the material it contains. They feel that here for the first time they have been supplied with reliable information on how to apply electric power to farm operations. The information obtained from this bulletin will not only prevent many farmers from installing improper equipment, but will help them to determine where and how to apply electric service with profit to farm work. I believe that a proper distribution and use of this bulletin will do a great deal toward guiding farm electrification along sound lines.

The district farm service man should demonstrate the proper installation of equipment by getting certain farmers in his district to cooperate with him in properly and rather completely electrifying their farms. There are always a certain number of farmers in each community who are very glad to cooperate with farm service men of the utilities, and to obtain from such men the engineering help and assistance which they are willing to give. This insures to the individual

farmer a proper installation of each device that he wants to use and also provides a good example for his neighbors. Such demonstrations have proven very effective, resulting in many proper installations which otherwise would not have been made, in the more satisfactory performance of the equipment for the customer, and in the saving of the money which is always wasted when a job is done over.

The district farm service men should help the farmers in buying equipment. If the farmer wants to buy it from the utility company, arrangements should be made so that it will be convenient for him to buy it this way. Naturally, the farm service man would prefer to have the purchase made from the utility company, and it is perfectly proper for him to show the farmer why he thinks it is better to buy from his company. It is very important, however, if the farmer decides to buy elsewhere, that the farm service man cooperate with him in securing proper equipment to fit the conditions under which it is to work.

When the farm service man is actually selling equipment, he is doing commercial work, should cooperate very closely with the department handling the sale of equipment, and, in fact, may be considered a part of that organization. But farm electrification involves so many problems other than merchandise sales that the farm service men should be given separate consideration outside of the commercial department. The farm service man must be the contact man between the utility company and the farmer in all matters so there should be a sufficient number of these men in each district to make this possible. The district farm service man is a most essential part of any utility organization which is trying to bring about general farm electrification.

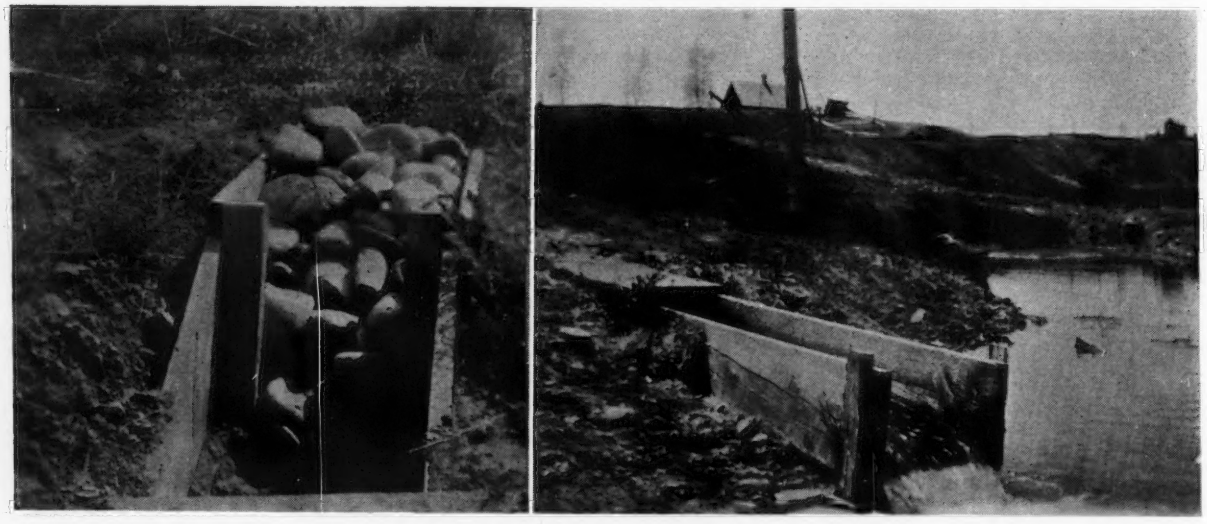
While the district farm service man guides and is largely responsible for the development of farm electrification in his district, there are many problems arising which give him trouble and, therefore, it seems advisable to employ a division farm service man. He also should be agriculturally trained and should, of course, be grounded in the fundamentals of the utility business. He will be kept busy handling special farm service and installation problems that will arise in the districts under his supervision, helping and guiding the district farm service man, addressing groups of farmers contemplating extension of electric service to their territory, and working with the operators of those model, completely electrified farms in each district which I have mentioned. In other words, he is the man that the district farm service man falls back on whenever he needs help or gets into trouble.

The directing force in farm electrification is a central rural service department in the general office. This central department, of course, is in the last analysis responsible for the development and gives much assistance to the division and district service men. It follows the work closely and determines where assistance is needed and then sees that such assistance is supplied. It keeps in touch with the work being done by other companies, analyzes it, and passes on to the field offices anything which is of value to the field men. The head of this department should be an agriculturally trained man and should report to an operating executive who has a voice in developing the policy of the company, for in any new development of this kind many questions of policy will arise which will require a definite decision. District and division farm service men report to the district and division managers, thus tying in the farm work with the general organization.

Companies who have organized in this or a similar manner are rapidly extending their lines to serve farms, are giving the farmers in their territory satisfactory attention, and are rapidly building up the individual farm load. Farm lines that were unprofitable to the company are being made profitable and at the same time the farmers served from such lines are getting more for their money and are better satisfied. These and many other desirable results follow when utility executives actually believe in farm electrification and properly organize for it.

During the past three years many utility companies of this country have added special rural service men to their operating organization and are aggressively extending their lines to supply farm service. A recent survey showed more than 400 men employed by utility companies to devote their entire time to farm electrification. A very large percentage of these men have been employed during the past three years and many of them are agricultural engineering graduates. Undoubtedly the requirements of utility companies for men with agricultural engineering training will increase rapidly and the supply may not be equal to the demand.

A survey in 1923 shows 225,000 farmers receiving central station service in the United States. Surveys of certain sections of this country indicate that about one-half million farmers are now receiving 24-hour electric service. This indicates that farm electrification is developing very rapidly. You can be assured that with your constructive help and cooperation and that of other interested organizations, the utility companies of this country will do whatever is necessary to extend 24-hour electric service to the farms of this country just as they have already supplied it to the widely scattered villages and hamlets.



(Left) A rock-filled sump for admitting surface drainage water into a drain tile in an irrigated section of the country. (Right) Outlet of a box drain. The Montana station has found the box drain to work satisfactorily.—Photos by courtesy of H. E. Murdock

Soybean Harvesting Methods in Virginia

By D. C. Heitshu[1]

THE question of harvesting soybeans for seed is one of growing importance in Virginia. In 1925 approximately 15,000 acres were harvested for seed, producing an average yield of 14 bu. per acre, or a total of 210,000 bu. In all probability no less than 90,000 bu. of seed were lost in this harvest, which represents a monetary loss of at least $250,000 to the farmers of the state.

The soybean acreage throughout the eastern and southern states is mounting rapidly. In 1924 W. F. Simpson[2], of this station, conducted a study of soybean harvesting and found the methods then in use expensive and wasteful of seed. Since that time the importance of the soybean crop has increased, and along with it the farmers' interest in saving a larger portion of the seed. Several of the more ingenious farmers have made harvesters of their own design.

This interest, along with the introduction of the combine into Virginia, led the Virginia Agricultural Experiment Station and the United States Department of Agriculture to undertake a study of the comparative merits of the different soybean harvesting methods practiced during the season of 1927. The methods observed during this study were (1) the cut and thresh, (2) the row harvester, (3) the broadcast harvester, and (4) the combine.

In conducting the study the yield of soybeans was first determined by harvesting 40 ft. of drill row by hand. This yield sample was cut in ten units of 4 ft. each. It was found that a more representative sample could be obtained by cutting two rows 2 ft. long at each point, rather than one row 4 ft. long. The yield per acre was computed on the basis of this sample. After conducting several tests, in which the natural shattering was estimated, the shattered beans were collected with the yield sample from the same area, weighed, and the exact natural shattering computed. The yield, used as the basis for loss calculations, was considered as the beans actually held by the stalks. The harvesting losses were determined by gathering and weighing the shattered beans, the pods on the stubble, and any loose stalks, from an area of 12 sq. yd., and the results were converted to bushels per acre. Blanket tests for threshing efficiency were conducted when possible, and moisture and physical analysis samples were taken regularly. Other data secured were relative humidity, soil type, slope, machine adjustments and speeds, variety of beans, conditions of crop, and miscellaneous notes.

Cut and Thresh Method. Table I contains the data obtained from the cut and thresh method. It is unfortunate that this test could not be completed, but the weather and distance interfered with the plans. The figures obtained are very representative, for the majority of soybean growers we interviewed agreed that the loss of beans varies between one-quarter and one-half of the total yield. The method used by Mr. Browning is that commonly followed in Virginia in harvesting soybeans for seed. The beans are cut with a mower, when half or three-quarters of the leaves have fallen, and allowed to dry in the swath. When the beans are dry they are raked into windrows and cocked. The raking usually is done in the morning to keep shattering as low as possible. Once the beans are in the cock they may be threshed immediately or left for some considerable time until the custom thresher arrives.

The cut and thresh method is sometimes modified by using a grain or corn binder in place of the mower. This procedure is desirable since it slightly reduces the losses, but the farmers do not care to use their grain binders for such heavy work, and the corn binder, which can only be used on row plantings, usually does a poor job of binding.

The major losses when this method is used occur in getting the beans into the cock. The subsequent losses are variable depending upon the hauling and threshing methods followed, varying from 5 to 15 per cent of the total yield. It is frequently difficult to secure a good threshing job from the custom thresher. A physical analysis sample was secured from a custom thresher which showed it to be doing a job equal to the poorest of the combines. Furthermore, this sample was taken after the thresherman had been assisted in making several adjustments to improve the operation of the thresher. Captain Somers was paying this thresherman 35 cents a bushel for threshing these beans and stated that he was losing at least 50 per cent of the beans by the cut and thresh method. From all appearances he was correct in this statement.

Row Harvester Method. The row harvester was very popular until the broadcast method of seeding became the almost universal practice among soybean growers in this state. The row harvester is a special soybean machine. It consists of a cylinder of long beater arms mounted on the front of the harvester which runs astride the row. The cylinder runs at a comparatively high speed and flails the beans from the pods into the separator mechanism at the rear of the cylinder. The separator, which is a simple vibrating sieve, cleans the beans of the larger and heavier trash but to make them marketable they must be run through a fanning mill. The beans are collected under the separator in a grain box which is unloaded by means of a shovel.

As would be expected, the shattering losses for this type of harvester are very high. The beans harvested on Dr. Andrews' farm were standing erect, hence the losses indicated in Table II can be considered average for this type of machine. Very few of these machines are in use at present, but growers' estimates as to the losses incurred in this harvesting method check closely with the test results.

Broadcast Harvester Method. The shift from row cultural methods to broadcast seeding of soybeans immediately made itself felt in the harvesting process. The row harvester could not be used, and though the mower and rake worked very well the labor involved was high, providing an incen-

[1]Assistant agricultural engineer, Virginia Agricultural Experiment Station. Jun. Mem. A.S.A.E.

[2]Journal of the American Society of Agronomy, Vol. 17, No. 9, September, 1925.

TABLE I. Soybean Harvesting Test Data—Cut and Thresh Method
Farm of R. D. Browning, Orange, Virginia
(Laredo variety)

October 7-14, 1927	Sample weight, ounces	Bushels Per Acre — Yield	Losses	Per cent
Yield—10-4-ft. sections in 8-in. drill rows	6.75	11.48		100.00
Loss behind rake—stalk loss—12-1 sq. yd.*	0.37		0.15	1.34
Loss behind rake—shattering loss—12-1 sq. yd.	1.54		0.65	5.63
Loss in windrow—stalk loss—3-3-ft. sections in windrows	4.34		1.26	11.00
Loss in windrow—shattering loss—3-3-ft. sections in windrows	2.67		0.78	6.76
Cock, hauling and threshing losses not recorded				
Total		11.48	2.84	24.73

*Loss samples were secured from 1-sq. yd. areas, twelve of these being selected at representative points in the field.

TABLE II. Soybean Harvesting Test Data—Scott Single-Row Harvester
Farm of Dr. Andrews, Orange, Virginia
(Virginia variety)

October 15, 1927	Sample weights, ounces	Bushels Per Acre — Yield	Losses	Per cent
Yield—5-4-ft. sections in 42-in. rows	38.81	25.18		100.00
Shattering loss—4-1 sq. yd.	6.81		8.58	34.10
Stubble loss—4-1 sq. yd.	1.25		1.57	6.25
Total		25.18	10.15	40.35



Two views of the Union harvester, the first broadcast soybean harvester, developed by Harvey S. Clapp. (Left) Harvester from the bullwheel side showing cylinder, bagger, and operator's platform. The grain hood has been removed to show beater arms on cylinder. (Right) Rear view showing cleaning riddle and bagging elevator

tive for the development of a simple, cheap, and efficient broadcast harvester. Two harvesters have been developed by Virginia farmers to meet this need.

The first broadcast harvester, known as the Union harvester, was developed by Harvey S. Clapp, of Accotink, Virginia. This machine is fundamentally the same as the old row harvester, i.e., it beats the beans from the pods by means of a long armed cylinder, and cleans them upon a separator at the rear of the cylinder. It has not met with much success simply because it has never been properly constructed. The machine which Mr. Clapp built in his own farm shop probably worked better than any of those produced commercially. The loss from these machines has been slightly less than for the row harvester because of the increased width of the machine, which reduces the side shattering loss, and through the improvement of the elevating element of the separator. It was not possible to obtain any test figures on this type of harvester in 1927.

R. D. Browning, of Orange, Virginia, built a harvester in 1925 which has been used experimentally. This harvester was built on the frame of an old 5-ft. binder, and, by arranging the canvas to run on an upward slope to the rear, the beans are carried from the cutter bar to the feed rollers as shown in the accompanying sectional view. The upper feed roller is spring weighted and hence will allow for variations in the amount of beans fed to the cylinder. In the experimental machine, the cylinder is constructed of wood and consists of four bars, the outside diameter being 20 in., and is geared to run 850 r.p.m. at 3.5 m.p.h. The cylinder bearings are adjustable on the frame so that the clearance between the feeder rolls and the cylinder bars can be changed to meet the condition of the beans. The feeding mechanism and cylinder have been changed but little since Mr. Browning first built his harvester, while several important changes have been made on the separator. The present separator, which seems very satisfactory to Mr. Browning, consists of a slotted sieve over which the beans are moved by a slat and belt carrier. The beans drop through the sieve and are carried back to the grain pan by the carrier on its return travel, while the vines are ejected at the rear. The vines and beans are fed to the separator from the cylinder by means of a beater roller, immediately back of which is a check curtain to catch flying beans. The pan under the cylinder has a solid bottom, but it is believed that better separation could be obtained if this were changed to a grate. The beans in the grain pan are fed to the bullwheel side of the machine by a grain auger, and there cleaned over a small riddle with an air blast, and bagged. The cleaner in use last fall was not of sufficient size to clean the beans well. This fault can be corrected easily.

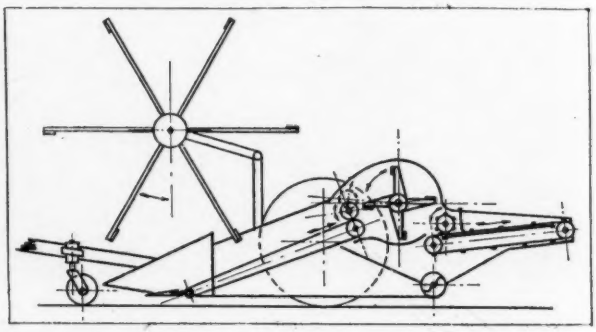
For a machine built from odd parts about the farm, in a farm shop, it holds great promise as a soybean harvester, especially for the small grower. The machine cuts the vines and delivers them to the cylinder with a "stalk and stubble" loss, and a "shattering" loss equivalent to that of the combine. Under rough field conditions this loss would be lower than for the combine because of the shorter cutter bar. No accurate counts of these losses were made. Two blanket tests were conducted to determine the threshing and separating efficiency of this harvester, the results of which are presented in Table III. Some of the shattered beans on the blanket resulted from leaks in the grain pan, and other parts of the machine, which would not occur in a well-constructed harvester. Other leakage losses occurred about the cleaner and bagger, but as the threshed beans were only partially cleaned before measuring, it was assumed that the losses were compensated for by foreign material present in the beans.

Both Mr. Clapp and Mr. Browning have secured patents on their soybean harvesters. While the market for such a harvester may be comparatively small, it should be sufficient to attract some responsible implement manufacturer. Virginia alone has many soybean growers who could profitably use a small soybean harvester, but who cannot purchase or rent a combine.

TABLE III. Soybean Harvesting Test Data—Browning Harvester
Farm of R. L. Hill, Orange, Virginia
(Virginia variety)

October 11-14, 1927	Sample weight, ounces	Bushels Per Acre Yield	Losses	Per cent
Yield—10-4-ft. sections in 7-in. drill rows	8.75	17.0		100.00
Test No. 1—Oct. 11, 1927				
Blanket test while harvesting 14 qt.				
Shattering loss	27.75		0.95	5.60
Beans left in stalks	46.13		1.59	9.32
Cutter bar losses not recorded				
Total		17.0	2.54	14.92
Test No. 2—Oct. 14, 1927				
Blanket test while harvesting 15 qt.				
Shattering loss	21.75		0.73	4.29
Beans left in stalk	34.13		1.14	6.72
Cutter bar losses not recorded				
Total		17.0	1.87	11.01

The Combine Method. The combine proved to be the best harvester of soybeans now available. The average total



Sectional view of the Browning harvester

TABLE IV. Soybean Harvesting Test Data—Case Combine
Farm of B. G. Locher, Glasgow, Virginia
(Virginia variety)

Test No. 1—October 21, 1927	Sample weight, ounces	Bushels Per Acre Yield	Losses	Per cent
Yield		38.7		100.00
Natural shattering—approximately 1 per cent		0.4	0.4	1.00
Total yield—10—4-ft. sections in 8-in. drill rows	23.00	39.1		
Total shattering—12—1 sq. yd.	6.69		2.82	
Cutter bar shattering			2.42	6.25
Stalk and stubble loss behind cutter bar—12—1 sq. yd.	7.00		2.94	7.58
Blanket test—loss in threshing 1 bu. of beans	2.31		0.09	0.24
Total		38.7	5.45	14.07
Test No. 2—November 11, 1927				
Yield—10—4-ft. sections in 7-in. drill rows	12.00	23.30		100.00
Natural shattering—with yield sample	1.50	2.91	2.91	12.50
Total yield		26.21		
Total shattering—12—1 sq. yd.	7.19		3.02	
Cutter bar shattering			0.12	0.51
Stalk and stubble loss behind cutter bar—12—1 sq. yd.	2.75		1.16	4.95
Blanket test—not recorded—approximately 0.5 per cent			0.12	0.50
Total		23.3	1.40	5.96
Test No. 3—November 16, 1927				
Yield—10—4-ft. sections in 7-in. drill rows	12.38	24.05		100.00
Natural shattering—with yield sample	0.25	0.49	0.49	2.00
Total yield		24.54		
Total shattering—10—1 sq. yd.	1.38		0.58	
Cutter bar shattering			0.09	0.38
Stalk and stubble loss behind cutter bar—10—1 sq. yd.	2.35		1.23	5.10
Blanket test—not recorded—approximately 0.5 per cent			0.12	0.50
Total		24.05	1.44	5.98

TABLE V. Soybean Harvesting Test Data—McCormick-Deering Combine
Farm of Capt. A. Somers, Lively, Virginia
(Virginia variety)

October 25, 1927	Sample weight, ounces	Bushels Per Acre Yield	Losses	Per cent
Yield		34.23		100.00
Natural shattering—approximately 8 per cent		2.97	2.97	
Total yield—10—4-ft. sections in 8-in. drill rows	21.94	37.20		
Total shattering—12—1 sq. yd.	10.44		4.37	
Cutter bar shattering			1.40	4.09
Stalk and stubble loss behind cutter bar—12—1 sq. yd.	10.32		4.33	12.65
Blanket test—loss in threshing 5 pecks of beans	4.63		0.13	0.39
Total		34.23	5.86	17.13

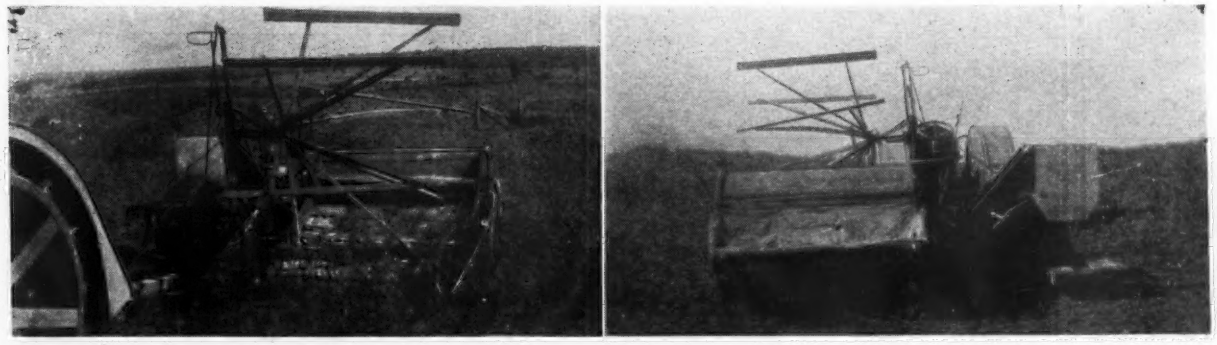
TABLE VI. Soybean Harvesting Test Data—McCormick-Deering Combine
Farm of Richard Pratt, Fredericksburg, Virginia
(Virginia variety)

October 26, 1927	Sample weight, ounces	Bushels Per Acre Yield	Losses	Per cent
Yield		21.00		100.00
Natural shattering—approximately 7.5 per cent		1.57	1.57	7.50
Total yield—10—4-ft. sections in 7-in. drill rows	11.63	22.57		
Total shattering—12—1 sq. yd.	9.75		1.10	
Cutter bar shattering			2.53	12.05
Stalk and stubble loss behind cutter bar—12—1 sq. yd.	1.50		0.63	3.00
Blanket test—not recorded—approximately 0.5 per cent			0.11	0.50
Total		21.00	3.27	15.55

losses for the three combines tested were 11.74 per cent, ranging from a maximum of 17.13 per cent to a minimum of 5.96 per cent. These losses are very low when it is considered that the Virginia soybean, the only variety harvested by the combines, is primarily a hay variety, hence growing close to the ground and with a great deal of vine. This made close cutting impossible, in fact the stubble was usually several inches longer than the height of the cutter bar above the ground.

Tables IV, V and VI summarize the combine tests. Table IV covers the three tests made upon the controlled combine, while Tables V and VI are of the tests made on machines owned and operated by farmers. The first of the tests on the controlled combine was conducted under the worst of crop conditions, the vines being 5 to 6 ft. in length and lodged until the average height of the mass was 12 to 15 in. The topography was rolling so that seldom could a place be found where the entire combine would sit level. Under these conditions a total loss of 14.07 per cent was lower than might be expected. The second and third tests were conducted under more favorable conditions. The growth of vines was not as rank as in the first field, and the beans stood better as a result. The average height of the beans in the second field was 21 in., and in the third test area they stood 30 to 33 in. high. The land in these fields while of rolling topography caused no trouble. The losses in the second and third tests are what may be expected from a combine properly operated in an average crop of beans. The stubble loss would have been less in both fields had the vines not been lodged by a heavy rain and wind when young. The cutter bar was operated at approximately 4 in. above the ground, yet the stubble measured 5 to 8 in. in length, and the average lowest pods were 6 in. from the root crown.

Captain Somers' combine showed the highest losses of all



(Left) Front view of Browning broadcast soybean harvester showing elevator and feeder rolls. (Right) Rear view of harvester showing grain elevator and small sized cleaner used



(Left) McCormick-Deering combine doing a very good job of harvesting soybeans on the farm of Richard Pratt, Virginia. (Right) This picture shows a condition of crop very common with Virginia soybeans

the combines. Table V indicates how this loss was incurred. The conditions under which this machine operated were adverse. The vines averaged 54 in. in length and were lodged to a height ranging between 12 to 16 in. While the crop conditions were bad, the stubble loss, which represents five-sevenths of the total loss, resulted from a combination of crop conditions, undulatory topography, and a rigid cutter bar. A floating cutter bar would probably have reduced this loss at least one-half. The conditions found in this field were slightly more favorable than those encountered in the first field harvested by the controlled combine, yet the loss was higher simply because the rigid cutter-bar failed to conform to the topography of the field. The resulting stubble was from 5 to 10 in. in length, although at a few points the field was shaved clean, while at others the vines were not touched by the cutter bar in its passing.

The combine operating on Mr. Pratt's farm near Fredericksburg, Va., was doing a nice job of harvesting, but unfortunately the beans had been standing too long and the shattering was extremely heavy (Table VI). This field was level and the soil was well prepared before seeding. Furthermore, the soil was rather thin, hence the beans grew erect making them easy to harvest. Had these beans been cut several days earlier the losses resulting would have been, in all probability, the lowest of any of the combine tests as the conditions would have been practically ideal.

The last two combines mentioned indicate clearly what may be expected of one-man rigid cutter bar combines under Virginia conditions. If the conditions are nearly ideal this type of combine will operate efficiently, but when average to adverse conditions are met the machine is found wanting. Captain Somers used four men to operate his combine. Two tractor operators were employed, one driving the tractor while the other manipulated the combine tilting lever. These men changed jobs every few rounds of the field. A third man was used to tie bags. This man would not be needed if a grain tank was used. However, with this type of combine a grain tank tends to raise the outer end of the cutter bar as the tank fills and forces the main wheel into the ground under the added weight. This would tend to increase the stubble loss. The fourth member of the crew was a boy whose duty it was to prevent the vines from lodging on the deck and subsequent choking of the cylinder. Combining under these conditions is not very economical.

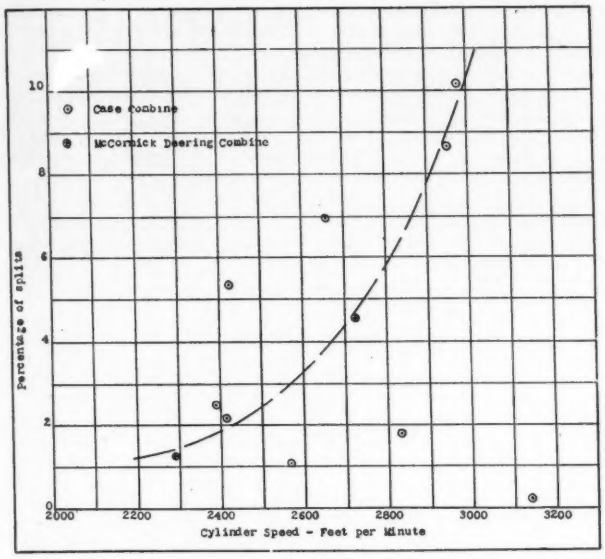
The rigid cutter bar combine has one distinct advantage over the floating cutter bar type as it is now constructed. This advantage is an enclosed feeder housing. An open feeder housing has two disadvantages: (1) Loss of beans shattered by the cylinder, and (2) dust annoying the operator. The loss of beans from the feeder housing was never accurately determined, but it is sufficiently high to warrant its prevention. The same loss also occurs in combining small grains, although it is not as important as in soybeans. The safety of the operator is concerned in this loss as the flying beans are a menace to the operator's eyes, necessitating the wearing of suitable goggles. The dust from soybeans is extremely irritating. Enclosing the feeder housing and protecting the combine operator from the dust produced by the cylinder materially increases his efficiency. The comfort and safety of the operator are as important as the mechanical perfection of the machine he is operating.

The combine on Captain Somers' farm was the only one equipped with a power take-off drive. For many reasons this type of drive is unsatisfactory under Virginia conditions, and is not to be recommended. The size of tractor, crop conditions, soil and topography found in this state favor the auxilliary engine drive. The added investment is justified, provided the engine is demountable and equipped with a belt pulley so that it can do belt work about the farm.

The primary troubles encountered in combining soybeans were the splitting of the seed, and the difficulty of securing clean threshing. The cylinder speeds recommended for soybeans by the manufacturers of the two combines tested are 600 r.p.m. for the McCormick-Deering and 585 r.p.m. for the Case. These speeds are equivalent to a peripheral speed of 2,860 and 3,330 ft. per min., respectively. Experience has shown, however, that these speeds are too high for the Virginia variety of soybeans and in no case was a combine operated up to the rated cylinder speed. The speeds were reduced below those recommended by throttling the engines, but this was unsatisfactory as the engines did not have sufficient power to handle the heavy vines encountered in most

TABLE VII. Soybean Harvesting Test Data—Physical Analyses and Germination Tests

Date	Owner	Harvester	Clean seed		Splits		Damaged		Foreign Material		Total		Germination per cent	Hard seed, per cent
			Weight, ounces	Percent	Weight, ounces	Percent	Weight, ounces	Percent	Weight, ounces	Per cent	Weight, ounces	Percent		
10-15-27	Andrews	Scott Row	29.25	96.78	0.88	2.91	0.09	0.31			30.22	100.00	72	16
10-11-27	Hill	Browning	28.74	91.69	0.06	0.20	0.03	0.01	2.51	8.01	31.34	100.00	56	32
10-14-27	Hill	Browning	42.50	98.85	0.36	0.83	0.14	0.33			43.00	100.00	80	20
10- 6-27	Locher	Case Combine	25.08	88.60	0.87	3.07	1.48	5.22	0.89	3.13	28.32	100.02	92	2
10-21-27	Locher	Case Combine	26.94	86.10	2.72	8.68	0.89	2.83	0.75	2.41	31.30	100.02	84	14
10-22-27	Locher	Case Combine	24.05	89.75	1.86	6.94	0.39	1.45	0.49	1.84	26.79	99.98	98	2
10-28-27	Locher	Case Combine	22.64	87.05	2.64	10.15	0.21	0.82	0.52	1.99	26.01	100.01	98	
10-29-27	Locher	Case Combine	22.39	98.53	0.03	0.13	0.12	0.55	0.18	0.78	22.72	99.99	76	8
11- 1-27	Locher	Case Combine	25.81	94.82	0.91	3.36	0.43	1.58	0.06	0.22	27.21	99.98	84	12
11- 2-27	Locher	Case Combine	30.86	98.40	0.33	1.06	0.07	0.24	0.10	0.33	31.37	100.02	94	2
11- 7-27	Locher	Case Combine	45.68	96.10	1.18	2.49	0.09	0.19	0.59	1.25	47.54	100.02	98	2
11-11-27	Locher	Case Combine	40.70	95.55	0.92	2.16	0.72	1.68	0.26	0.61	42.60	100.00	88	2
11-16-27	Locher	Case Combine	36.75	97.70	0.66	1.75	0.12	0.33	0.08	0.21	37.61	99.99	90	2
11-22-27	Locher	Case Combine	49.37	94.06	2.81	5.35	0.11	0.22	0.20	0.37	52.49	100.00	98	
10-24-27	Somers	McC-D Combine	33.33	91.44	2.51	6.88	0.29	0.80	0.32	0.88	36.45	99.99	94	6
10-25-27	Somers	McC-D Combine	29.13	92.74	1.42	4.52	0.08	0.24	0.78	2.50	31.41	100.00	96	4
10-26-27	Pratt	McC-D Combine	29.67	96.48	0.38	1.22	0.02	0.06	0.69	2.24	30.75	100.00	66	24
19-25-27	Somers	Thresher	21.87	87.35	1.81	7.23	0.05	0.20	1.31	5.23	24.04	100.01	82	10



Graph showing the relation of cylinder speed to splitting of Virginia soybeans

fields. Further, the separator speed being lowered the cleaning was poor and the tailings heavy, which in every case increased the percentage of splits.

The Case combine was operated with standard soybean equipment until November 1, 1927, on which date the 20-tooth cylinder sprocket, which drives the separator, was replaced with a 27-tooth sprocket. This change increased the cleaning efficiency of the machine and helped to reduce the splitting of the seed. Table VII gives the data covering all physical analyses and germination tests conducted in connection with this work. Before the 27-tooth sprocket was put into use the foreign material averaged 2.07 per cent, while after its installation the percentage of foreign material dropped to 0.49. The average increase in separator speed was 8 to 10 per cent; i.e., the straw racks were run at approximately 240 vibrations per minute while the recommended number is 222 per minute. Previous to the change to the larger sprocket a great deal of trouble was experienced with the straw racks, riddle, and sieves loading with broken pieces of vine, pods, etc., but with the increased separator speed this trouble entirely disappeared. The decrease in percentage of splits which accompanied this sprocket change is shown in Table VII. Ability to reduce the cylinder speed and fewer tailings account for this. The performance of the

TABLE VIII. Soybean Harvesting Test Data—Effect of Cylinder Speed Upon Splitting of Beans
(Virginia variety)

Date	Combine, make	Diameter cylinder, inches	Cylinder-Speed		Moisture	Splits
			r.p.m.	ft. per min.	Per cent	Per cent
10-21-27	Case	21.75	518	2950	12.1	8.68
10-22-27	Case	21.75	466	2660	14.3	6.94
10-28-27	Case	21.75	522	2975	15.6	10.15
10-29-27	Case	21.75	550	3135	14.8	0.13
11- 2-27	Case	21.75	448	2565	12.4	1.06
11- 7-27	Case	21.75	420	2390	11.6	2.49
11-11-27	Case	21.75	424	2415	12.0	2.16
11-16-27	Case	21.75	496	2830	15.5	1.75
11-22-27	Case	21.75	425	2425	14.3	5.35
10-25-27	McC-D	18.00	578	2725	13.5	4.52
10-26-27	McC-D	18.00	486	2290	12.6	1.22

controlled combine was further improved November 7 by placing a special pulley on the cylinder which allowed the engine speed to be brought to normal.

The effect of cylinder speed upon the percentage of splits is summarized in Table VIII, and shown in the accompanying graph. The curve drawn is the probable one for average combining conditions and many exceptions may be expected. For example, on October 29 the physical analysis showed the percentage of splits to be 0.13 with a cylinder speed of 3,135 ft. per min. The field notes throw some light on this: "Fog heavy; lifted at 9:15. Beans damp and did not crack. Cylinder running 550 r.p.m. No trouble with rear loading. Later in day cracking began. Slowed speed to 500 r.p.m. Trouble with rear loading." The data available indicates that the cylinder speed for the Virginia soybean should not be over 2,500 ft. per min., and that 2,300 ft. per min. is preferable.

The question of proper threshing in the combining of soybeans is one that depends to a large extent on the operator's judgment. The proper use of concaves is essential, for it is possible, with damp beans and too few concaves, to lose as high as 5 per cent of the beans over the rear of the machine. Furthermore, under certain conditions it was possible to thresh beans with very little splitting using six rows of concave teeth, while at other times the splits ran very high using all blanks in the concaves. The best preventives of this trouble are to have concaves than can be easily and quickly removed or replaced, and to do a little educational work among the operators.

A number of minor troubles were encountered. Cylinder choking was the most common trouble. It resulted mainly from uneven feeding. The grain divider was one cause of this trouble. The dividers now in use fail to part the vines efficiently, and as a result the vines collect on the deck and enter the feeder housing in a large mass. In the Case combine the removal of the down beater from the feeder housing helped reduce cylinder choking. The down beater would



Combining soybeans in the Blue Ridge Mountains of Virginia. (The three peaks in the background are Jackson, Lee and Beauregard. This is in Rockbridge County, Virginia, the county in which Cyrus H. McCormick built his first reaper)

TABLE IX. Soybean Harvesting Test Data—Moisture Samples
(Virginia variety)

Identification of sample	Date	Moisture, percent	Remarks
R. G. Locher	Oct. 6	18.7	From Case combine
Glasgow	Oct. 18	23.9	Harvested by hand after 24 hr. rain
	Oct. 21	12.1	From combine, 1:45 p.m.
	Oct. 22	14.3	From combine, 1:45 p.m.
	Oct. 28	15.6	From combine, 1:45 p.m.
	Oct. 29	14.8	From combine, 1:45 p.m.
	Nov. 1	13.1	From combine, 1:45 p.m.
	Nov. 2	12.4	From combine, 1:45 p.m.
	Nov. 7	11.6	From combine, 1:45 p.m.
	Nov. 11	12.0	From combine, 1:45 p.m.
	Nov. 16	15.5	From combine, 1:45 p.m.
	Nov. 22	14.3	From combine, 2:15 p.m.
Taken from	Nov. 3	14.1	Harvested with combine, Oct. 19 to 29
Locher's	Nov. 22	13.5	From field No. 1, or Sample No. 1
beans in	Nov. 22	12.6	From field No. 2, or Sample No. 2
storage	Nov. 22	11.9	From field No. 3, or Sample No. 3
	Nov. 22	13.0	From field No. 4, or Sample No. 4
	Dec. 14	14.1	Sample No. 1
	Dec. 14	12.3	Sample No. 2
	Dec. 14	12.9	Sample No. 3
	Dec. 14	12.7	Sample No. 4
	Dec. 14	12.8	Sample No. 5
	Dec. 14	13.0	Sample No. 6
R. L. Hill	Oct. 10	12.9	From Browning harvester
	Oct. 11	12.9	From Browning harvester
	Oct. 14	11.7	From Browning harvester
Dr. Andrews	Oct. 14	13.0	Harvested with Scott single-row machine
	Oct. 15	12.5	Harvested with Scott single-row machine
Mr. Pratt	Oct. 26	12.6	From combine
Capt. A.	Oct. 24	11.9	From combine, 4:15 p.m.
Somers	Oct. 25	13.5	From combine
	Oct. 25	13.3	From thresher

wrap with vines and then suddenly throw the entire mass into the cylinder. The result is obvious.

Wrapping on the reel and reel shaft was very common. One partial preventive for this trouble is to remove the vertical board from the grain divider, but other than this no remedy was discovered. An adjustable reel might help in correcting this trouble.

More serious of the minor troubles is the wrapping of crab grass or similar weeds about the deck canvas rollers. No cure was discovered except a large sized jack knife. An overhanging lip on the rear of the cutter bar might aid in reducing this trouble. Some remedy should be sought as this trouble takes considerable time from the harvesting operation, and the growth of this type of weed is very prevalent in our soybean fields.

Soybeans can be cleaned of all trash and stored immediately upon harvesting. The moisture contents of all samples are recorded in Table IX. Soybeans will store satisfactorily with a relatively high moisture content because of the high percentage of oil present in the bean. However, in most cases the moisture content of harvested beans is sufficiently low for safe storage. The only sample running high in moisture was that of the first day's operation of the controlled combine, and this sample contained a large number of green beans. On October 18 a sample was cut from Mr. Locher's field after 24 hr. of rain and threshed by hand. The moisture content of this sample was only 23.9 per cent. Three days later, when the ground was dry enough for the combine to operate, these same beans showed a moisture content of 12.1 per cent as they came from the combine.

SUMMARY

1. The present soybean harvesting methods are very wasteful of the seed.
2. Special soybean harvesters are needed under certain conditions, and two experimental machines have been made by Virginia farmers.
3. The combine is a very successful soybean harvester.
4. The combine with rigid cutter bar and one-man control is not suitable for average Virginia conditions.
5. The power take-off type of drive is not recommended for combines in Virginia.
6. A cylinder speed of 2,300 to 2,500 ft. per min. is recommended for the Virginia soybean.
7. An increase of 8 to 10 per cent in the separator speed is desirable for soybeans.
8. Improvements to better the operation and lengthen the serviceable life of the combine are needed on all machines.
9. Soybeans can be harvested and stored without special attention or equipment.

AUTHOR'S NOTE: Acknowledgment is made of the valuable assistance of Messrs. Hurst and Cummings, division of agricultural engineering, U. S. Bureau of Public Roads; Messrs. Morse, Barr and Lee, division of forage crops, U. S. Bureau of Plant Industry; and Mr. Alvis, department of agricultural engineering, Virginia Polytechnic Institute, in this work. The cooperation given by the farmers mentioned herein, the J. I. Case Threshing Machine Company and the International Harvester Company was splendid, for through it alone was this work possible.

An Animal Husbandry Man on "Horses"

JACK TURNER, livestock specialist for the Missouri-Pacific Lines, predicts that the farm horse is soon to be a curiosity, a relic of the past.

In an article in the May issue of "East Texas" he recalls the discussion of a few years ago as to the relative merits of geldings, mules and brood mares on the farm, and points out that the brood mare lost out first when the decreasing value of horses and mules forced the center of their production from the farm to the range where there was cheap grass and where large scale production was possible.

Following up this point he says, "Machines have made further invasions on the farm until now if the small farmer would compete with those in the prairie region, he must come to the use of machines also. Up to the present time the small farmer has been faced with the handicap of machines that are ill adapted to his purposes, but the new agricultural engineering profession is solving these problems very rapidly. It will be only a matter of a very few years then until the horse will be as much of a curiosity on the farm as he is in the cities at the present time."

There has been no decrease in the demand for beef, pork, mutton, poultry and milk, and the feed formerly fed to horses should logically be turned into these products according to Mr. Turner. Increased production of livestock of this class, improved breeding of livestock and pasture improvement are his recommendations for farm relief in Eastern Texas. His position is summed up in the concluding paragraph of his article as follows:

"East Texas farmers are entering into a new area of livestock production. They must recognize the handwriting if they would continue in business. They should not run after any false ideas of farm diversification, either in crops or in livestock production, and the horse is going the way of all antiquated farming methods. We are losing what has been a valuable asset in him, the consumption of surplus feed and the conversion of it into useful work. But now that the day has arrived when this work may be more efficiently and economically done by machines, and the feed that he consumes may be more profitably converted into meat, wool, eggs and milk; regardless of our sentiments, we should let this faithful servant of the past go the way of all those whose usefulness is over and turn to the new and more economical system where every product must produce a profit."

Magnet Clears Roads

A LARGE electromagnet owned by South Dakota and tested on the roads of that state has picked up surprising amounts of puncture-making rubbish. In covering 1,285 mi., 10,280 lb. of iron scraps, including nails, bolts, wire, wood screws, and even fish hooks and razor blades, were picked up. This is an average of 8 lb. per mi. The magnet is 7 ft. long and is suspended under a truck between the front and rear wheels. It is operated by a motor and generator on the truck.

Substitutes For Breakpins—Spring Overload Release Hitches[1]

By E. G. McKibben[2]

AS AN effective method of protecting implements against excessive stresses due to the sudden stopping of the implement by a relatively solid obstruction, the spring overload release hitch deserves a wider consideration by designers and operators of farm tractors and tractor-drawn implements. A properly designed spring overload release hitch may combine most of the advantages of both the breakpin and the simple shock-absorbing drawbar spring, without the more serious disadvantages of either.

Advantages. The following are some of the advantages which may be obtained by the use of a properly designed and well-built spring overload release hitch:

1. Protection of the implement against excessive stresses under all conditions of load and speed
2. Relatively infrequent replacement of parts (The breakpin must be replaced each time the load is released.)
3. Rather accurate adjustability over a relatively wide range of loads
4. An appreciable elongation of the hitch before release, thus absorbing under some conditions enough of the kinetic energy of the tractor to prevent the necessity of releasing the hitch.

Disadvantages. Like all others this type of overload protection has certain disadvantages, as follows:

1. The first cost is usually higher than either a simple shock-absorbing drawbar spring or provision for the use of a breakpin
2. If it is to give satisfactory service it will have to be adjusted occasionally
3. The inconvenience of rehitching is a disadvantage in comparison with the simple drawbar spring, provided the conditions are such that the situation can be satisfactorily handled by a simple drawbar spring.

Desirable Characteristics. The spring overload release

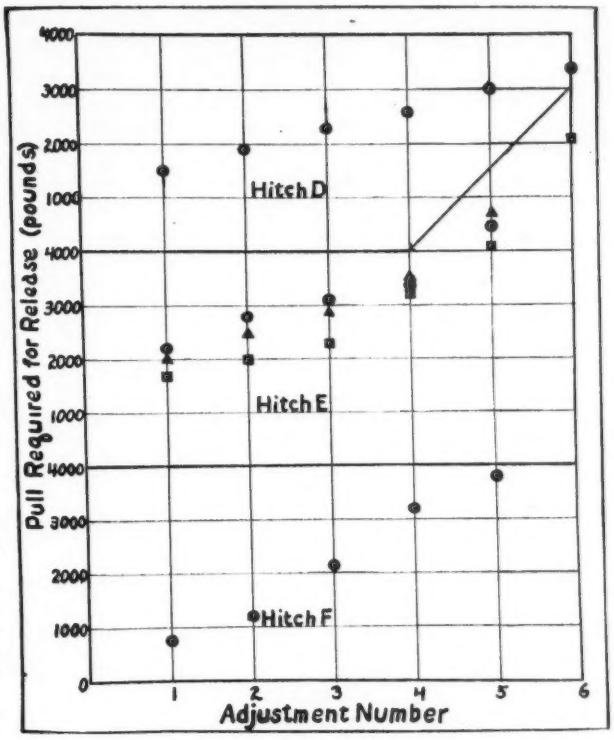
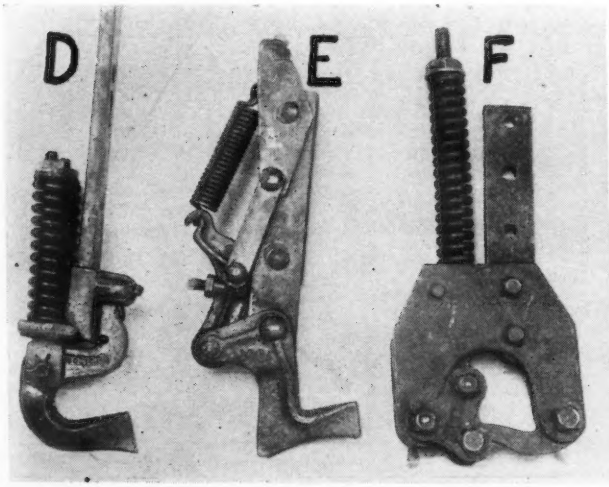


Fig. 5. Effect of uniform changes in adjustment upon the pull required for release. In the series of tests of Hitch E shown as circles nut "b" (note Fig. 2) was adjusted to give spring "a" a tension of 150 lb. at adjustment No. 1 of capscrew "c". Nut "b" was left at this adjustment during the series. In the series shown as triangles nut "b" was adjusted to give spring "a" a tension of 150 lb. for each adjustment of capscrew "c". Likewise in the series shown as squares, nut "b" was adjusted to give spring "a" a tension of 100 lb. for each adjustment of capscrew "c"

[1]Third and last of a series of articles on substitutes for breakpins. The first, entitled "Results of a Study of the Strength of Wooden and Metal Breakpins," by A. H. Hoffman, and the second, entitled "Substitutes for Breakpins—Drawbar Springs," by Mr. McKibben, appeared in the May and June issues, respectively, of AGRICULTURAL ENGINEERING (Vol. 9, Nos. 5 and 6).

[2]Assistant agricultural engineer, University of California. Mem. A.S.A.E.

[3]Published in the first article of this series, May 1928 issue of AGRICULTURAL ENGINEERING, Vol. 9, No. 5, page 144.



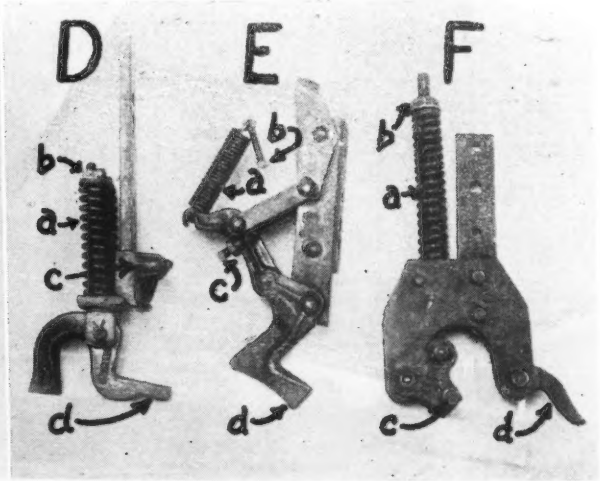


Fig. 1. (Left) Three typical spring overload release hitches. Fig. 2. (Right) Spring "a" of hitch "E" was disconnected in order to show the hitch in the released position. Normally this hitch returns to the position, shown in Fig. 1, as soon as the load has been released

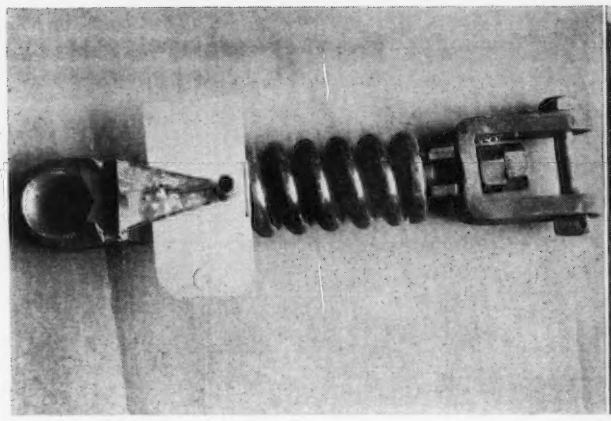


Fig. 3. (Left) Recording shock dynamometer.



Fig. 4. (Right) Method of testing the hitches

hitch should have as many as possible of the following characteristics:

1. Uniformity of pull required for release at any given adjustment
2. Pull, required for release, proportional to adjustment
3. Minimum wear of tripping mechanism, that is, designed so that trip mechanism is subject to the smallest practicable forces, with trip mechanism made of high quality materials
4. Minimum effect of a given amount of wear on the pull required to release at any given adjustment
5. Adjustability for correcting effect of wear
6. Convenient, inexpensive replacability of wearing parts
7. Ease and convenience in rehitching after release
8. Positive hitch, so that the implement may be backed and otherwise maneuvered without possibility of its being released unless it is subjected to the predetermined overload
9. Method of locking against release to be used to prevent the possibility of a runaway when pulling a relatively free rolling load on a steep grade.

A Study of Three Hitches. In order to get a better idea of the possibilities and limitations of the spring overload release hitches available at the present time, a brief study was made of three hitches. These hitches were obtained from three representative implement manufacturers, and, as shown in Figs. 1 and 2, they are of decidedly different types. The results reported below were obtained by use of the recording shock dynamometer, shown in Fig. 3, between the hitch being studied and the implement, as shown in Fig. 4.

Although we believe that the results of this study as given below are very much worth while and give a rather definite idea of the operating characteristics of these hitches, we wish to call attention to the following limitations of such a study:

1. No attempt was made to study all the spring overload release hitches on the market.
2. There were not enough tests made to determine the effect of wear due to long-continued use.
3. There was no attempt to determine the effect of long periods of weathering.
4. While the elongation of the hitch due to the shock dynamometer used was only 0.05 in. per 1000 lb. of pull, conditions under a suddenly applied pull were not quite the same as they would have been without the dynamometer in the hitch.
5. The dynamometer was read only to the closest 100 lb.

Test at Uniformly Varied Adjustment. The tests shown in Fig. 5 were made to determine the approximate relation

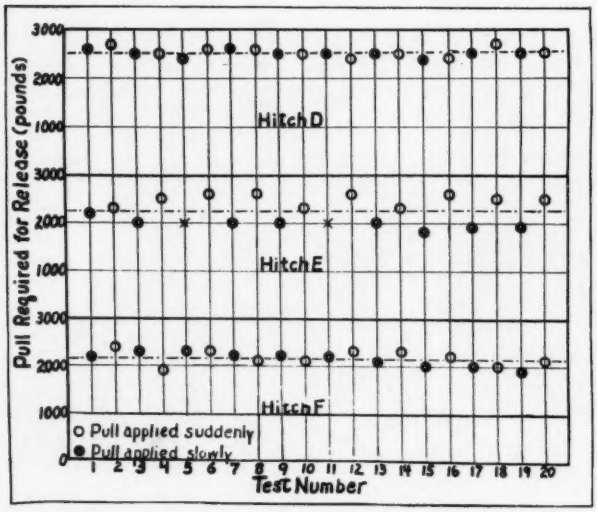


Fig. 6. Note the uniformity of the results of these 20 tests at the same setting

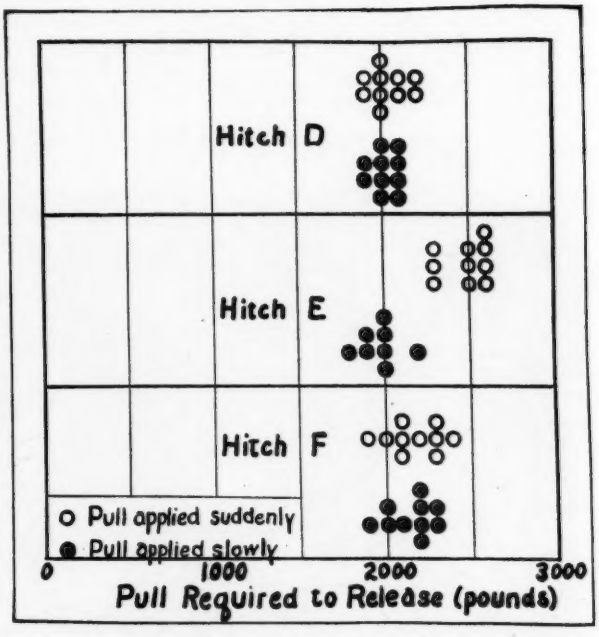


Fig. 7. Showing effect of wear due to use and effect of speed of application of pull on pull required to trip release when set at a given adjustment. In Test 5 and 11 of Hitch E, the hitch tripped but the hook caught on the clevis so that the load was not released until the pull was over 4000 lb.

TABLE I. Result of Twenty Tests at the Same Adjustment*

	Hitch D	Hitch E	Hitch F
Maximum	2700	2600	2400
Minimum	2400	1800	1900
Average of slowly applied pulls	2510	1975	2140
Average of suddenly applied pulls	2540	2420	2170
Average of all tests	2525	2255	2155
Average of first four tests	2575	2250	2200
Average of last four tests	2575	2200	2000

*Slow steady and sudden jerky applications of the drawbar pull were alternated during these tests.

between uniform changes in adjustment and the pull required for release. The change in adjustment was, for Hitch D, 01 in. in the relative location of latch "a"; for Hitch E, one half turn of capscrew "c"; and for Hitch F, two and three-quarter turns of nut "b" (Note Figs. 1 and 2). No change was made in the adjustment of nut "b" in Hitch D, because this would have had practically the same effect as a corresponding change in the location of latch "c". Two additional series of tests were also run with different adjustments of nut "b" of Hitch E. These are explained in connection with Fig. 5.

Test of Constant Adjustment. To give an idea of the uniformity of the pull required for release at a given adjustment, the effect of speed of applying the pull, and the effect of wear due to use, twenty tests at the same adjustment and in which slow and sudden applications of the drawbar pull were alternated, were run on each hitch. The results are shown in Table I, and in Figs. 5, 6 and 7. It should be noted that these results are much more uniform and consistent than those obtained with wooden breakpins.

CONCLUSIONS

Considered as a group the hitches studied included most of the desirable characteristics of an ideal spring overload release hitch. There also appears to be no fundamental mechanical reason why almost all of these desirable characteristics can not ultimately be combined into a single spring overload release hitch. Where there is actual need for overload protection, such a hitch if properly cared for and adjusted should give more satisfactory performance than breakpins.

Lighting Farm Buildings With Carbide Gas

By Clara Woolworth[1]

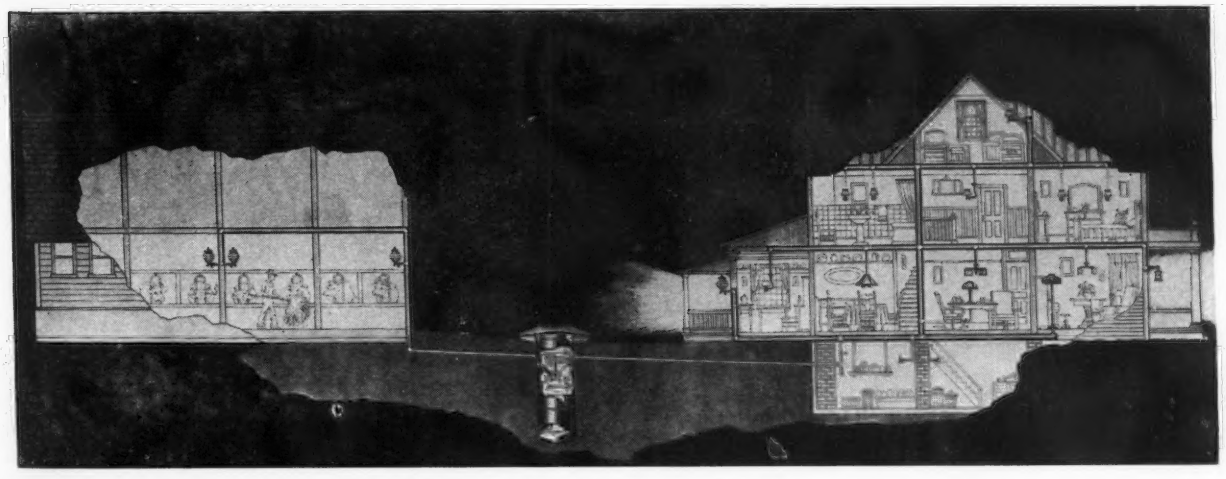
CARBIDE gas (acetylene) is one of the two important agencies employed for lighting farm buildings and for supplying adequate time and labor-saving equipment in the farm home. Its availability everywhere makes it worthy of serious consideration in connection with the lighting of practically all buildings and premises which are located out of range of low-priced and satisfactory service from central electric and city gas plants. There are now several hundred thousand farm homes equipped with some form of carbide gas generator, some of which are early models that have been in use for twenty-five years or more.

It is well that all agricultural engineers should understand that very definite progress has been made in recent years in perfecting carbide generators and equipment used in conjunction with them. The purchaser or intending user is amply safeguarded if he takes care that the generator sold him is of a type that is listed as standard and permitted by the Underwriters Laboratories, Inc., of Chicago, maintained by the National Board of Fire Underwriters. The list of standard acetylene generators, which is issued by the Underwriters Laboratories each year, gives the purchaser quite a selection of makes, and it can be taken for granted that all of the carbide generators listed are constructed in accordance with strict specifications laid down by that organization, thus insuring a mechanically efficient and safe machine.

Some of the generators listed are what are known as the indoor type, while others are of the pit type. During the last few years there has been a tendency for manufacturers to devote more energy to the perfection of pit type machine than to the indoor type; and at the present time the majority of generators being manufactured are of the improved pit type. One reason for this is that basements of farm homes are of limited capacity and there is not, as a rule, space in which to install a generator with large carbide and water capacity. The indoor generator is practically limited to a carbide capacity of less than 100 lb., whereas in the case of the outdoor pit type machine, capacities up to 200 lb. of carbide are commonly installed.

The average farmer wants a device which requires a minimum amount of attention. The small indoor type of machine has to be replenished with carbide and water once

[1]Director of women's division, educational department, J. B. Colt Company. Chairman, A.S.A.E. Subcommittee on Lighting (Other than Electricity). Assoc. Mem. A.S.A.E.



General view of a carbide gas lighting installation. It shows the method of piping the gas and indicates how the fixtures may be installed. The system is flexible and can be adapted both as to fixtures and piping to the needs of the house and other buildings

every month or so; whereas in the case of the outdoor machine it requires attention only at infrequent intervals.

One objection to the indoor type of machine is that there is necessarily a certain amount of odor which penetrates through the home, at the time residue is drawn off from the machine and when it is being replenished with fresh water and carbide. This is obviated when the work is done outside.

The improved pit type generator consists of four principal parts: (1) the carbide holder, in which the supply of carbide is contained; (2) the generator tank, containing the a marked degree, but effect pronounced economies in time water into which the carbide falls, and in which the gas is generated; (3) the gasometer bell, which absolutely controls the generatation of the gas as it is needed, and which is weighted to give the proper pressure (3 in. water column. or 1¾ oz. to the square inch), and (4) the filter, the function of which is to free the gas of moisture and particles of lime dust which might otherwise be carried along with the gas to the burners.

The generator operates by the force of gravity. As gas is used it is taken from under the gasometer bell. The bell falls by gravity, and in doing so operates the carbide feed mechanism, causing a small quantity of carbide to be fed into the water in the generating chamber. Gas is made when the calcium carbide comes in contact with the water and the gas raises the gasometer bell. In rising, the gasometer bell releases the feed valve, and stops further carbide from falling into the generator tank until sufficient gas is used to lower the gasometer bell again, when the process is repeated.

The gas is piped to the house and other buildings in ordinary gas pipe and the generator itself operates automatically, needing attention only three or four times a year, in the case of the 200-lb. capacity generator, when the residue is cleaned out and a fresh supply of water and carbide is introduced.

This residue is for the greater part slaked lime of an exceptionally high quality. It can be used for all of the many purposes for which commercial slaked lime is used, and has some added advantages since, in the terrific heat of the electric furnaces in which the calcium carbide is produced, the lime is burned to an exceptional degree of fineness. This quality makes carbide residue particularly valuable in the making of whitewash for barns, poultry buildings, fences, etc. The residue can also be employed to good advantage as a disinfectant, a soil sweetener, a preservative for wooden posts set in the ground and many other purposes.

The quantity of carbide necessary is placed in the hopper at the top of the generator and the gas bell, which rises and falls in a water seal as the gas is supplied and drawn off, operates the carbide outlet so that enough carbide is dropped into the water to keep the gas supply sufficient at all times.

The amount of carbide required during the year depends of course upon the amount of gas consumed, but it has been determined that on the average farm 200 to 500 lb. of carbide will suffice for a year's operation of the plant, and that the cost of carbide represents practically the only cost over an extended period of years since there is little or nothing about the equipment to get out of order or require replacement.

Modern lighting fixtures in the form of wall brackets, chandeliers, table lamps and artistic floor lamps are provided. Lighting burners designed to consume one-half, three-fourths or one cubic foot of carbide gas per hour are available. Practically all lighting burners are equipped with automatic igniters.

The cost of installation depends to some extent upon the number of gas outlets provided and on the character and quality of the fixtures selected. The fixtures can be ornate or plain as desired.

All installations of generators listed as standard by the Underwriters' Laboratories should comply with the regulations of the National Board of Fire Underwriters for the installation and operation of acetylene equipment, edition of 1924. The installations are made by trained men known to the manufacturers to be reliable. Before leaving the job the installer fully instructs the purchaser as to the method of cleaning out and refilling the generator and in giving such care as is necessary.

In making such installations due care is taken to protect the generator against freezing and in sections where the frost goes below three feet suitable protection is provided to prevent the water from freezing. The piping is laid underground with suitable "drip pots" placed at low points to prevent any water of condensation from collecting in the pipes. In piping an old house as well as a new one, particular care is taken to conceal the pipe in the walls, floors and ceilings. Outlets are provided for at the most suitable points to take care of the convenience and needs of the household.

In addition to light, a carbide gas generator supplies gas for cooking through the use of a three-burner hot plate with portable oven or a regular low oven gas range having four top burners and two oven burners. A self-heating carbide gas flat iron is also a great convenience. This additional equipment will save the farm homemaker much time and effort at a comparatively small cost. The five-flame burners consume 3.17 cu. ft. of gas per hour, the seven-flame burners 3.85 cu. ft. per hour, and the eight-flame oven burners consume 3.47 cu. ft. per hour.

The artificial lighting of barns safely and adequately has always been a serious problem on the farm and improved carbide gas barn lights, which are rated as standard by the Underwriters' Laboratories, Inc., have been put through all possible safety tests and have proved thoroughly satisfactory in actual operation.

By running a gas pipe to the poultry house and placing specially built carbide gas poultry house lights in proper position so that the perches as well as the scratching floor will be lighted during certain hours, dark mornings or evenings or both, the working time of the hens can be equalized throughout the year and egg production maintained at practically a constant level. The fact that the quality of carbide gas light is so close to that of sunlight makes is particularly valuable for poultry houses.

The Problem of Spontaneous Farm Fire

LOSS of a hay barn through fire caused by spontaneous combustion at the very time the barn and the hay in it are standing in three feet of water indicates the need for extensive research into the problem of what is commonly known as "spontaneous combustion," particularly of agricultural products such as hay and other cattle feeds.

In New England the dairy farmers require a considerable supply of hay and other feeds for the winter feeding of their herds. Much of this hay is stored in bays reaching from the floor to the roof of the dairy barn. A striking and unusual illustration is that of a barn located in the region flooded in Vermont last fall. Flood waters entered many barns, and in this one wet the hay to a depth of 17 feet. As the flood waters receded intense heat production followed in the mass of wet hay. "Spontaneous" heat production began in the lower layers, and the hot gases rising through the stacks caused strong draughts or "flues." The moisture thus carried upward condensed in the cooler parts of the hay or in the air above, wetting the hay in the immediate area. So many of these draughts existed in some piles that the hay was thoroughly soaked. Temperatures in typical "flues" ranged from 116 to more than 165 deg. F. This barn experienced the height of the flood on Friday morning, November 4, and burned late Monday afternoon, November 7. Much heating was observed on Sunday and Monday a distinct odor of charring was noticeable.

This was only one of many fires during last year caused by spontaneous combustion. This combined with unknown causes results in approximately $60,000,000 loss each year to the farmers of the United States, and accounts for more than one-third of all the annual farm fire loss of $150,000,000. In the national fire bill of $570,000,000 loss to the nation, spontaneous combustion ranks fourth in the causes of fire, and is exceeded only by losses resulting from lightning, defective flues and heating apparatus, and matches and smoking.—David J. Price, chemical engineer, U.S.D.A. Bureau of Chemistry and Soils.

Power and Labor Studies in Pennsylvania[1]

By H. B. Josephson[2]

POWER and labor have been found to constitute from 21 to 58 per cent of the total cost of producing farm crops, according to investigations made by the Pennsylvania State College on actual farms in Lancaster County[3].

The aim of the studies reported in this paper is to determine wherein the power requirements and the labor requirements of the operations involved in crop production in Pennsylvania may be reduced to a profitable minimum by engineering procedure. This project was organized in 1925 by R. U. Blasingame, professor and head of the department of farm machinery of the Pennsylvania State College.

Preliminary to attacking specific problems the solution of which might result in reducing the cost of major operations in crop production, it was deemed necessary to make an analysis of the whole power and labor situation. Each operation, as plowing, has been studied separately. The operation considered as a unit is again divided into its component items of cost—power, labor, and machinery. The results of this analysis are presented in this report.

Scope and Purpose of Study. The five principal field crops grown in Pennsylvania—corn, oats, wheat, hay and potatoes—were included in this study. In the production of these crops common Pennsylvania practice is considered as a base. New methods which have been coming into more general use have been given special attention and other new methods which seem to give promise of reducing costs have been studied when possible. These studies have been made with a threefold purpose: (a) To determine the power and the labor requirements of the various operations in the growing of these crops when different methods are employed and thereby establishing a base from which to make comparisons and seek improvements; (b) to determine how the new methods stand with respect to common practices, and (c) to determine which operations in given crops should be selected for more detailed study in efforts to reduce costs.

Sources of Data. All of the data were secured in Centre County under conditions which are typical of large sections of the state where the common rotation of corn, oats, wheat and hay is practiced. Small fields, averaging around 15 acres, which are irregular in shape and topography are typical of this section. The presence of tight limestone rock near the surface is a real hindrance to the efficient use of power and machinery. These conditions have largely determined the practices employed in field operations with respect to size of machines and power units.

The power and labor data were secured on the college farm under typical conditions as regards fields. The two sources of power ordinarily used on farms in this section, animal and mechanical, were given about equal attention in the gathering of data. The former must be considered as representing common practice due to its more prevalent use.

The most common power unit in this state, particularly under the conditions described above, is the team of two horses with the corresponding size of machine, as the 14-in. walking plow and one-row corn cultivator. Only in the case of harrowing and cutting grain are more than two horses frequently used on machines. The term "common practice," where later used in this report will refer to the most usual method of performing the operation with teams.

A two-plow general-purpose tractor of latest design was used for the purpose of obtaining data on the newest methods employed in this state.

Figures on machinery costs[4] were obtained from a survey made by personal interview on ninety-eight farms in Centre County[5]. By this method, reliable figures on common machines that have been in service for a long time were obtained. For the newer machines, however, particularly for potato machinery no such data were available. The cost of using those machines had to be obtained by making an estimate as to probable life and repair cost on the basis of figures for other machines.

Method of Securing Data. The power and labor data were secured on the college farm during the seasons of 1926 and 1927 by what might be called the stop-watch method. Fields of 20 acres or more were selected for corn, oats, wheat and hay. After being carefully surveyed these were divided into

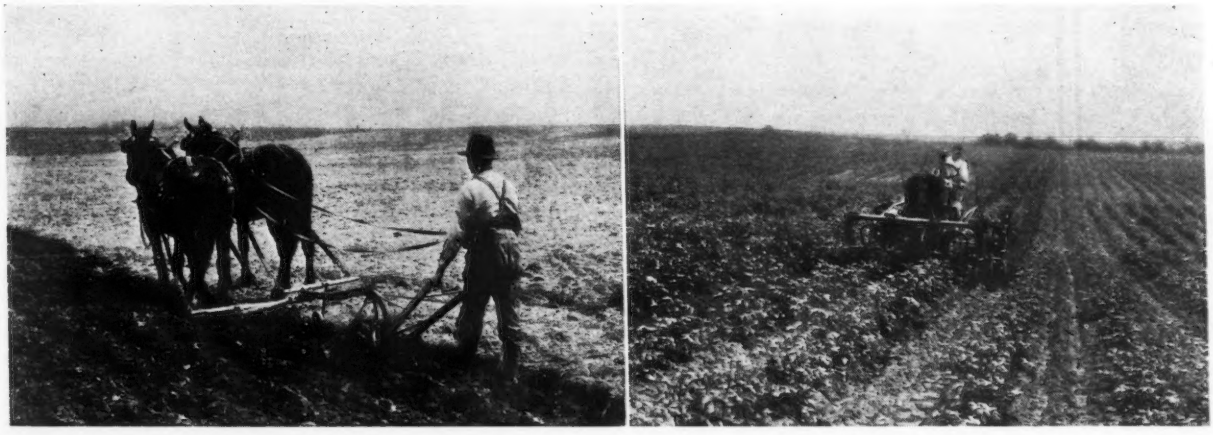
[1]Progress report on a research project on farm power and labor studies in Pennsylvania, published as Technical Paper No. 450 of The Pennsylvania State College, School of Agriculture and Experiment Station. Released for exclusive publication in AGRICULTURAL ENGINEERING.

[2]In charge of farm machinery research, Pennsylvania State College. Mem. A.S.A.E.

[3]Summary of Cost of Production Records in Lancaster County, 1921-1925. The Pennsylvania State College, School of Agriculture and Experiment Station, Farm Management Extension. For a more detailed account of these cost records and the organization and preliminary plan of this project on power and labor studies see AGRICULTURAL ENGINEERING, Vol. 6, No. 11, p. 273. (November 1925).

[4]"Machinery costs" as used in this report refer to the cost of using a power-drawn machine, as a plow or a spraying machine. The cost of using a tractor is listed as power cost and not machinery cost.

[5]Acknowledgment is made to the Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture, for the tabulation of this data.



The most common power unit in Pennsylvania, particularly under the conditions observed in this study, is the two-horse team. A general-purpose tractor of latest design was used for obtaining data on the newest methods employed in the state, and for purposes of comparison with those followed in common practice

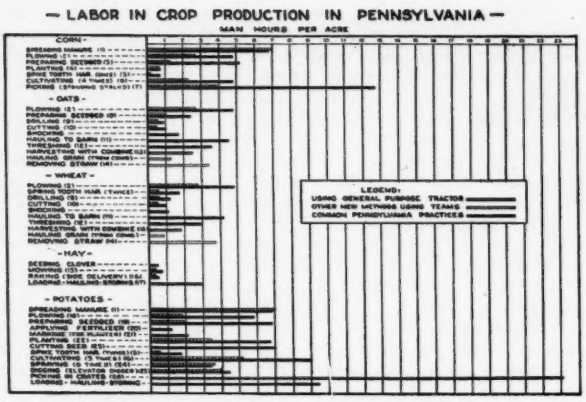


Fig. 1. Graphic presentation of the labor requirements of various operations in the five crops studied. Figures in parenthesis following each operation refer to these notes of explanation

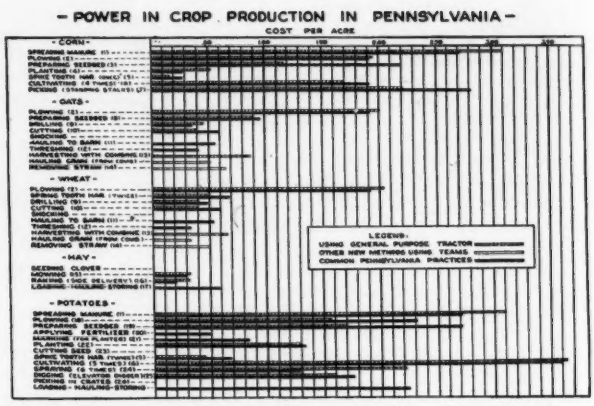


Fig. 2. Cost per acre for power alone in various operations. Power supplied by the general-purpose tractor is figured on actual operating cost for each job plus a fixed charge of 50 cents per hour. Power supplied by a horse is figured at 20 cents per hour

two equal parts. One-half of each field was then worked entirely by common Pennsylvania practice, using teams, while the other half was worked as far as possible with the general-purpose tractor. Some wheat, oats and corn harvesting was done outside of the fields specially set aside for the work in order to have sufficient acreage for conclusive results.

Time records are in all cases based on actual time in the field. In the case of the tractor studies, careful records were also kept on fuel and oil used for each job; also a full record was kept on repairs and time for making repairs. Dynamometer records were taken on most operations but were not considered of direct value for this report.

Labor in Crop Production. The labor requirements of the various operations in the five crops studied are presented graphically in Fig. 1, on the basis of man-hours per acre. This chart also gives a comparison between the labor requirements of most operations when performed with a general-purpose tractor and when performed with teams following common Pennsylvania practice. An explanation of the methods employed in performing the various operations, is given in another part of this report. The cost of labor is figured at 30 cents per man-hour when presented on a cost basis in this report[4].

Referring to Fig. 1, it is seen that a considerable reduction was effected in the labor requirements of most operations when a general-purpose tractor was substituted for common Pennsylvania practice. This is to be expected as the common size of power unit is the team of two horses.

In some operations, as planting corn for example, conditions made it impracticable to use a larger machine with the tractor than is ordinarily used with two horses and consequently no labor was saved by using the tractor. Planting corn is a minor operation and a saving of labor would be of little importance. Not so with spreading manure which takes more labor than plowing or seedbed preparation. No reduction in labor, but rather a slight increase was effected when the tractor was used for spreading manure.

In preparing the seedbed for all crops a very substantial reduction in labor was brought about by the use of a tractor. In corn, for example, common Pennsylvania practice required 5.2 man-hours per acre while only 1.3 man-hours, or one-fourth as much labor, was required when the tractor was used. In disking, harrowing and pulverizing the tractor was used at full load with little or no interference from rocks.

The presence of rocks accounts for the relatively small reduction in labor effected by the use of a tractor in plowing when compared with a team and walking plow. At the same rate of speed the two-plow tractor would plow an acre with only half as much labor as is used with a team and walking plow. Under favorable conditions the tractor would travel much faster, but due to the stony condition of the fields plowed for corn, oats and wheat the tractor could not travel at an average speed equal to that of the teams. This is not surprising as the spring release hitch between the tractor and plow was tripped as often as twenty times an hour to say nothing of slowing down over rough places. The labor requirements were reduced from 4.8 man-hours to 2.7 man-hours per acre by the use of a tractor. In plowing for potatoes the labor was reduced from 5.8 man-hours per acre with a team to 1.8 man-hours per acre with the tractor. The land used for potatoes was nearly free from stones and was in heavy alfalfa sod which slowed down the teams but had little effect on the tractor.

In cultivating corn and potatoes the labor requirements were reduced by approximately one-half when the general-purpose tractor with two-row cultivator was substituted for a team and the conventional one-row machine. A greater saving than that should have been effected especially in the case of corn but again the work was slowed down due to rocks. The quality of work was also affected more by rocks in the case of the tractor than with the one-row machine.

In potato growing the outstanding operation from the standpoint of labor requirements is that of picking the potatoes after they have been laid on top of the ground by an elevator digger (See Fig. 1). This is entirely a hand operation as practiced in Pennsylvania. The season for potato harvesting is short and often broken up by rainy spells. There is a real need for machinery that will cut down the labor requirements of potato picking.

Power in Crop Production. Fig. 2 gives the cost per acre for power alone in the various operations. This is presented on a cost basis in order to make a comparison between the general-purpose tractor and common practice. Table I gives an itemized statement of the cost of using the general-purpose tractor in this project for two years. The fixed charge for operating the tractor was found to be 50 cents per hour. To this was added the actual cost of fuel, oil and grease used for each operation. Power supplied by teams is figured at 20 cents per horse-hour.

When the tractor was used for operations of low load factor, as spreading manure, planting corn, spraying potatoes where considerable idling of the engine was necessary, the power cost was higher than that for common practice. In plowing for corn, oats and wheat the power cost for the tractor was slightly higher, while in plowing alfalfa sod (for potatoes), nearly free from stones, the power cost was considerably lower than for teams. In preparing the seedbed for all crops a reduction in power cost was effected by the use of a tractor. The small difference in the case of preparing the seedbed for oats is due to the fact that most of the work consisted of spring-tooth harrowing, and the corn stalks which had been plowed under were dragged out with the harrow. The harrow had to be lifted and cleared by hand every few minutes. This did not slow down the teams to any extent but seriously handicapped the tractor. In general it may be stated that on full load the cost of power supplied by the tractor was considerably cheaper than that supplied

[4]In the Summary of Cost of Production Records in Lancaster County, 1925, reported by the Department of Farm Management Extension of the Pennsylvania State College, man labor is figured at 30 cents per hour and horse labor at 20 cents per hour.

by teams while with the tractor operating at a small load the reverse was true.

TABLE I. Cost of Using General-Purpose Tractor

First cost—September, 1925 .....$890
Estimated useful life[1] .....10 yr.
Total time operated in two seasons—760 hr.

Cost for Two Seasons (1926 and 1927)

	Amount	Rate	Total	Per cent
Depreciation			$178.00	28.0
Interest (5 per cent)			85.00	13.3
Housing			20.00	3.1
Repairs			38.90	6.1
Labor making repairs (hr.)	106	$.35	37.10	5.8
Tractor chores (hr.)	57	.30	17.10	3.1
Kerosene (gal.)	1142	.15	171.30	26.9
Gasoline (gal.)	61	.21	12.80	2.0
Oil (gal.)	88.5	.80	70.80	11.1
Grease (lb.)	15.5	.25	3.88	0.6
Total Cost Less Operator			$634.88	100.0

Cost per hour $0.84
Cost per hour less fuel and oil $0.50

Total Cost of Field Operations. In Fig. 3 are presented the total costs of performing the various field operations in dollars per acre. This includes the cost of labor, power and machinery.

Plowing was done at a slightly lower cost with the two-plow tractor than with a team and walking plow in spite of the stony condition of the fields used for corn, oats and wheat. Under more favorable conditions (on the land used for potatoes) the cost of plowing with the tractor was $2.53 per acre as compared with $4.47 using common practice. In preparing seedbed a very substantial reduction in cost was effected in all crops by the use of the tractor as compared with common practice. Cultivating corn and potatoes was done at a considerably lower cost with the tractor; spreading manure and planting corn cost more while there was little difference in the cost of drilling and cutting grain, and mowing and raking hay when the two methods are compared.

Methods of Performing Various Operations

(For reference in using Figs. 1, 2 and 3)

CORN

1. **Spreading Manure.** (For corn and potatoes) Applied nine loads per acre. The tractor was used with two spreaders and was kept going almost continuously while one man loaded. Common practice—one man with two horses and spreader, the driver doing all the loading.

2. **Plowing.** (For corn, oats and wheat) Plowed 8 in. deep. The tractor was used with a two-furrow 14-in. plow equipped with spring release hitch. Common practice—two horses on 14-in. walking plow.

[1]Based on data from Somerset and Westmoreland Counties, Pennsylvania, 69 tractor owners estimated the useful life of their tractors. The average of these estimates was 10.4 years. The average life of these tractors when the survey was made (March, 1927) was 4.3 years. These tractors are operated on an average 36.1 days per year—12.7 days belt work and 23.4 days drawbar work. Data collected by Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture.

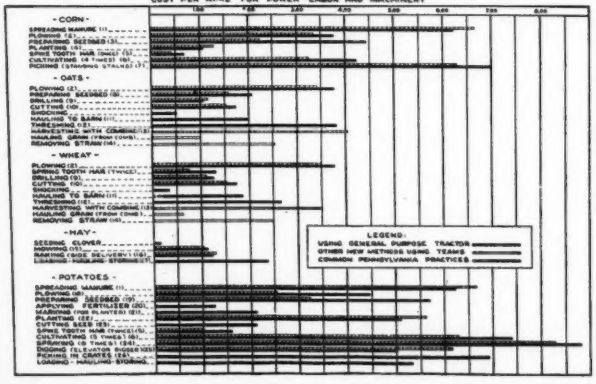


Fig. 3. Total costs of performing various field operations in dollars per acre, including labor, power and machinery

3. **Preparing Seedbed.** Pulverizing, double disking, spring-tooth harrowing three times. (See "Tillage Operations.")

4. **Planting.** Applied fertilizer. Corn was drilled, not checked. Tractor was used on ordinary two-row planter equipped with stub tongue. Lifting lever was made accessible from seat and also markers were lifted from seat. Common practice—two horses on two-row planter.

5. **Spike-Tooth Harrowing.** Once over, to kill weeds. Tractor was used on four-section lever harrow. Common practice—two horses on two-section harrow.

6. **Cultivating.** Tractor was used with two-row cultivating attachment. Common practice—one-row riding cultivator drawn by two horses.

7. **Picking Corn.** Yield 43 bu. per acre. Picking from standing stalks is not generally practiced in Pennsylvania but was the method used on the college farm previous to the introduction of corn borer control measures. A mechanical corn picker was drawn with the tractor and driven with power take-off. Two teams were used for hauling the corn to the crib, a wagon being driven alongside while being loaded. The cost of using the machine is based on an estimated life of 10 years and 30 acres' use each year. This method was being compared with the method of husking by hand, the crew consisting of two men with each team and wagon. Hand picking is listed as common practice.

OATS AND WHEAT

8. **Preparing Seedbed.** Pulverizing, spring-tooth harrowing twice for oats. Spring-tooth harrowing twice for wheat. (See "Tillage Operations.")

9. **Drilling.** Applied fertilizer. Tractor was used on a 12-disk, 7-in. space, power-lift drill. Common practice—two horses on eleven-hoe drill.

10. **Cutting.** Tractor was used on 10-ft. binder driven with power take-off and operated by one man. No grain was cut on the college farm with teams, but the figures used for common practice are from the Centre County machinery survey. Three horses are usually used on a 7-ft. binder.

11. **Hauling to Barn.** The common practice is to haul the sheaf grain to the barn and store it in the mow where it is later threshed. Crew consisted of 6 men and 2 teams. Average distance hauled about one-half mile.

12. **Threshing.** On barn floor during winter. Crew consists of seven men including machine operator. Cost based on 4 cents per bushel for oats and 6 cents for wheat for machine and two men. Yield—oats, 48 bu. per acre, and wheat, 20 bu. per acre.

13. **Harvesting With Combine.** The tractor was used for pulling a 9-ft. combine driven with auxiliary engine, two men operating the outfit. The cost is based on harvesting 100 acres per year and estimated life of 15 yr.

14. **Removing Straw Behind Combine.** The straw was left in a windrow behind the combine. Two of these windrows were brought together with a side-delivery rake. The straw was then loaded on a wagon by means of a hay loader, the wagon and loader being pulled by two horses. The load was hauled to a hay shed close by and unloaded by hand. The cost of using the haying machines is figured at one-half the cost of using them for hay making.

HAY

15. **Mowing.** The tractor was used with a 7-ft. mowing attachment driven with power take-off. Common practice—two horses and 6-ft. mower.

16. **Raking.** Tractor and team were used on side-delivery rake.

17. **Loading, Hauling, and Storing.** The loading was done with hay loader, the wagon and loader being drawn by two horses. The crew consisted of 6 men and 3 teams; two men built the load and one man worked in the mow. Average haul, about one mile. Yield, 1.5 tons per acre.

POTATOES

18. **Plowing.** Field with few stones. Plowed 9 in. deep. Same methods used as for corn.

19. **Preparing Seedbed.** Pulverizing twice, double disking, spring-tooth harrowing three times. (See "Tillage Operations.")

20. **Applying Fertilizer.** Used 8-ft. lime sower with two horses.

21. **Marking for Planter.** A two-row marker, drawn by two horses, was used for opening up the furrow ahead of the planter for the purpose of permitting deeper planting and making the space between the rows more uniform. The marker covers the ground twice, one shovel always following in the last mark of the preceding trip.

22. **Planting.** Applied fertilizer. The tractor was used on a two-row planter, one man riding the planter. The ground was not marked out beforehand. Spacing of rows 34 to 40 in. apart. Common practice, following marker with one-row planter, one man operating planter and another driving. Spacing of rows, 32 in. apart.

23. **Cutting Seed.** Cut by hand, 20 bu. per acre.

24. **Spraying.** The tractor was used on a four-row sprayer, the pump being driven through the power take-off. Common practice consists of using a four-row sprayer drawn by two horses, the pump being driven by a 4-hp. gasoline engine mounted on the sprayer tank.

25. **Digging.** The tractor was used on a two-row elevator digger, two men operating the outfit. Common practice—one-row elevator digger drawn by two horses.

26. **Picking in Crates.** Two men worked together, filling one-bushel crates, previously scattered throughout field. Yield, 180 bu. per acre.

27. **Loading, Hauling, Storing.** The crates were picked up, loaded on wagon, hauled to cellar, unloaded, and the empty crates brought back to the field to be refilled.

TILLAGE OPERATIONS IN ALL CROPS

Pulverizing. Tractor was used on an 8-ft. pulverizer. Com-

mon practice—two horses on 7-ft. pulverizer. This machine is sometimes known as a soil packer.

Disking. Tractor was used on a 6-ft. double disk harrow. Common practice—two horses on single-disk harrow.

Spring-Tooth Harrowing. Tractor was used on two and sometimes three spring-tooth Perry harrows covering 6 ft. each. Common practice—two horses on one harrow and sometimes four horses on two harrows.

Relation Between Cost of Power, Labor and Machinery. The distribution of power, labor and machinery costs in various operations is shown in Fig. 4 and Tables II and III. The cost figures are an average for all crops studied under this project. This distribution is of importance in pointing out where costs may be reduced. The sum of the three cost items—power, labor and machinery—determines the cost of the operation and the problem of reducing costs is to so manipulate the three items as to make their sum a minimum.

No general statement can be made as to the relation that should exist between the three items. It cannot, for example, be said that they should necessarily be equal, or nearly equal, in all cases. It is preferable that labor costs be lower than the other two items for the reason that power and machinery can be purchased and controlled as needed by the farmer, whereas extra labor may not be available when required.

The nature of certain operations makes machinery cost a large percentage of the total cost, as, for example, in planting corn, mowing and raking hay, and spraying potatoes. These operations as performed by common Pennsylvania practice are rather highly developed machine operations requiring a relatively small amount of power and labor. It is not likely, therefore, that the cost of such operations will be materially reduced except through improvements in the machines used. It is true, however, that where labor costs are high, as compared with power and machinery costs opportunities are favorable for reducing costs. In plowing, for example, using common Pennsylvania practice, labor constitutes 38 per cent of the total cost while machinery cost is only 11 per cent. Power cost is essentially high in plowing, and in this case is 51 per cent of the total. The plow used in this case was a walking plow. Larger plows, which would save labor, cannot satisfactorily be used with teams due to rocks. It is obvious that an increased machinery cost would be justified in this case, if it should result in a substantial decrease in the labor cost. In changing from common Pennsylvania practice in plowing to tractor plowing it will be seen from Fig. 4 that the power cost remained practically the same; the labor cost was reduced from $1.50 per acre to 88 cents per acre, while the machinery cost (the cost of using the plow) was increased from 41 to 61 cents per acre. The result was a decrease in the cost of plowing from $3.91 per acre with common practice to $3.47 using the tractor. The saving of labor is an added gain over and above the difference in cost. It should here be noted that a somewhat better job was done in stony places with the walking plow than could be done with the two-furrow tractor plow.

In some operations in potato growing the change from common practice to the general-purpose tractor resulted in what appears to be an excessive machinery cost. This is

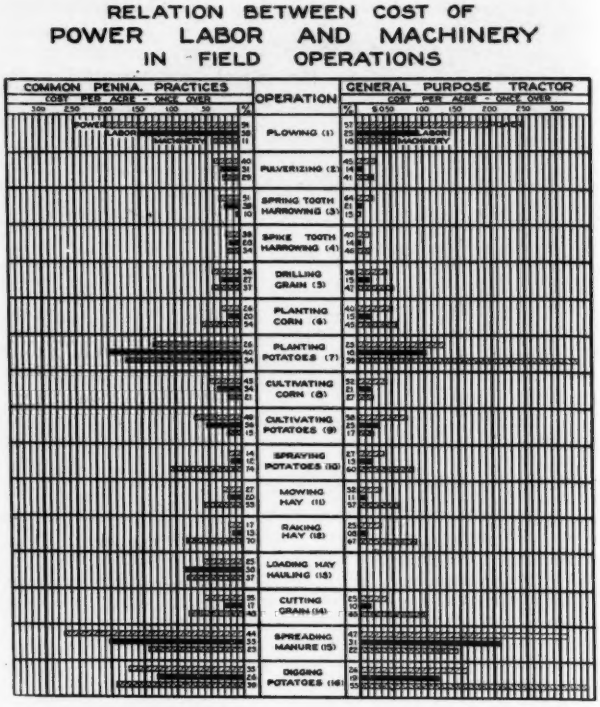


Fig. 4. Distribution of power, labor and machinery costs in various operations

*Machinery costs in potato growing are based on ten acres per year which is the average for commercial potato growers of the state.

TABLE II. Common Pennsylvania Practice
Summary of farm operations performed with teams
Cost per acre—once over

Operation	Power	Labor	Machinery*	Total
Plowing field with few rocks	$2.00	$1.50	$0.30	$3.80
Plowing moderately stony fields	2.00	1.50	.41	3.91
Plowing very stony fields	2.00	1.50	.48	3.98
Pulverizing	.37	.28	.26	.91
Spring-tooth harrowing	.32	.24	.06	.62
Spike-tooth harrowing	.23	.17	.20	.60
Drilling grain	.42	.31	.43	1.16
Planting corn	.28	.21	.58	1.07
Planting potatoes	1.34	2.01	1.75**	5.10***
Cultivating corn	.48	.36	.22	1.06
Cultivating potatoes	.72	.54	.22	1.48
Spraying potatoes	.21	.17	1.09**	1.47
Mowing hay	.30	.22	.59	1.11
Raking hay	.21	.16	.86	1.23
Loading hay and hauling to barn	.60	.90	.86	2.36
Cutting grain	.69	.30	.84	1.74
Spreading manure	2.72	2.04	1.46**	6.22
Digging potatoes	1.76	1.32	1.94	5.02

*Machinery costs are from Centre County machinery survey. The average crop acreage on these farms was: Corn, 19 acres; oats, 17.5 acres; wheat, 23.5 acres, and hay, 26 acres.
**Cost of using potato machinery could not be obtained from Centre County machinery survey. These costs are based on growing ten acres of potatoes each year which is the average acreage for commercial potato growers of the state.
***Marking not included—two-man planter.

TABLE III. General-Purpose Tractor Record
Cost per acre—once over

Operation	Power	Labor	Machinery*	Total
Plowing field with few rocks.	$1.40	$0.50	$0.43	$2.33
Plowing moderately stony fields	1.98	.88	.61	3.47
Plowing very stony fields	2.29	1.07	.71	4.07
Pulverizing	.29	.09	.26	.64
Spring-tooth harrowing	.25	.08	.06	.39
Spike-tooth harrowing	.17	.06	.20	.43
Drilling grain	.43	.17	.53	1.13
Planting corn	.52	.20	.58	1.30
Planting potatoes	1.31	1.02	3.30**	5.63
Cultivating corn	.42	.17	.22	.81
Cultivating potatoes	.73	.31	.22	1.26
Spraying potatoes	.37	.18	.83**	1.38
Mowing hay	.33	.11	.59	1.03
Raking hay	.32	.11	.86	1.29
Loading hay and hauling to barn				
Cutting grain	.39	.15	1.00	1.54
Spreading manure	3.10	2.10	1.46	6.66
Digging potatoes	1.60	1.17	3.40**	6.17

*Machinery costs are from Centre County machinery survey. The average crop acreage on these farms was: Corn, 19 acres; oats, 17.5 acres; wheat, 23.5 acres, and hay, 26 acres.
**Cost of using potato machinery could not be obtained from Centre County machinery survey. These costs are based on growing ten acres of potatoes each year which is the average acreage for commercial potato growers of the state.

true in planting and digging potatoes where two-row machines were used with the tractor, whereas one-row machines are used in common practice. As the acreage was the same in both cases[8] the machinery cost was almost doubled in case of the tractor operations. Considerable labor was saved in planting as two men operated a two-row planter, whereas in common practice two men operated a one-row machine. However, the increased machinery cost more than offset the saving in labor cost. The two-row planter was used in order to make it possible to use a two-row cultivator and also because it provided a better load for the tractor. The two-row digger was used because it provided a full load for the tractor and was expected to facilitate the operation of hand picking. No labor was saved as two men were required to operate the outfit, whereas one man operated a one-row digger in common practice. In both these cases the departure from common practice resulted in an increase in cost. As machinery cost figured on a per acre basis is very nearly an inverse ratio of the acreage covered by the machine each year, it becomes necessary to provide a certain minimum acreage in order to justify the use of a given machine. From the standpoint of cost alone it is apparent from these studies that an annual acreage of more than ten acres is necessary to justify the use of a two-row potato planter or digger. The data presented in Fig. 4 may similarly be used to determine the feasibility of using larger machines in other operations.

SUMMARY

When a general-purpose tractor was substituted for common Pennsylvania practice in field operations:

1. A large saving of labor was effected in most operations (Fig. 1).
2. Power costs were reduced in some major operations but increased in some minor ones due to low load factor (Fig. 2).
3. An increase in machinery costs in some operations partly offset and in some cases exceeded the reduction in labor cost (Fig. 4).
4. The total cost (power, labor and machinery) was reduced in many major operations but increased in some minor ones usually because of low load factor and sometimes because of high machinery cost (Fig. 3) both of which are results of small crop acreage.
5. Quality of work in cultivation, and in some cases in plowing, was not up to the standard of common practice due largely to the stony condition of the fields. In the design and development of the equipment used, no attempt has been made thus far to meet this condition. Improvements in this direction will be attempted.
6. A conclusive comparison of yields produced under the two methods could not be obtained from this preliminary study. It should be noted that in the case of potatoes the distance between the rows was of necessity greater when the general-purpose tractor was used than is common practice. A corresponding decrease in yield was the result.

It should be borne in mind that "common Pennsylvania practice" has been developed by the farmers of the state themselves over a long period of years and are thoroughly understood. On the other hand, the use of a general-purpose tractor is a new method, only two years old in Pennsylvania. The tractor used in this project was the first of its kind to be used in the state. Some of the equipment used had to be improvised and is not yet available commercially.

In some cases the saving in labor has brought about an increase in power and machinery costs as seen in Fig. 4. Yet, a farmer can purchase and therefore control power and machinery. On the other hand, he cannot control labor and have it available whenever needed. An improved machine when substituted for labor speeds up the work, makes it possible to do the job under most favorable conditions, and usually lightens the work.

CONTINUATION OF PROJECT

This preliminary analysis points out certain operations that seem subject to modification through improvements in machinery, or the development of new machines, which may result in a reduction in labor requirements, production costs, or both. With that end in view the following operations have been selected for more detailed study:

1. Plowing under stony conditions.
2. Mechanical cultivation of row crops.
3. Harvesting of small grains with the combined harvester-thresher.
4. Potato harvesting.
5. Haying operations.

Tornado-Resistant Building Possible

STRUCTURAL damage to buildings by tornadoes and the loss of life incident thereto may be avoided or reduced by designing buildings so they can more readily resist internal pressure.

Property damage to buildings by tornadoes may be divided into two classes—that caused by the explosive effect and that caused by flying debris. The explosive effect, usually the more serious, occurs as a result of a difference in atmospheric pressure set up by a tornado between the inside and the outside of a building. The sudden drop in external air pressure produces an internal pressure which frequently results in the blowing out of some portion of the building.

It is possible to relieve the internal pressure of air thus set up in a building by providing automatic vents in it. Observations made following the St. Louis tornado last September indicate that from 10 to 15 per cent of the outside walls and a similar area in the roof should be vented. There are a number of methods by which this could be done. If a sufficient number of windows or panels were designed so that they would open outward from internal pressure the necessary venting could be accomplished. Special windows equipped with hardware which would work on the same principle as the panic bolts used on exit doors in theaters would do the trick. Hinged panels for use in the spaces between window sills and floors and elsewhere in the side walls of a building is another venting possibility. Roofs may be vented by automatic dormer windows, by special skylights, or by hinged roof panels.

Such automatic vents could be installed in existing buildings as well as in new buildings. They could be used in all types of buildings, large or small, public or private, in the city or in the country—even to the farmer's barn or poultry house. The practicability of various venting methods could be tested in laboratories. This would offer opportunity to work out the most suitable types of vent construction.—L. V. Teesdale, forest products engineer, U.S.D.A. Forest Service.

An Elastic Farm House

"FARM HOUSE PLANS" is the name of Agricultural Service No. 18 recently issued by the Northwest Farm Managers Association. The purpose of this particular service is to provide a plan which can be built small at first and added to as the need arises without undue expense and that will give a well-planned house at each stage of its development.

Desirable features for a farm house in the north, as given, include kitchen on the northwest corner, full basement with laundry and cistern, cross ventilation in all possible rooms, especially the kitchen, grade entrance into the kitchen and basement. It is pointed out that a porch is of no use in the winter and in the summer no one has time to use it; that a cross-ventilated kitchen is equally comfortable; and that money saved by omitting a porch will contribute a great deal to the enlargement or improvement of the house in other ways.

Six stages in construction from a two-room bungalow to a ten-room, two-story house are named and briefly described. First and second floor plans of the completed house are shown, the rooms built at each stage being named in the description.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

Power Plant Testing, J. A. Moyer (New York and London: McGraw-Hill Book Co., 1926, 3. ed., rev., pp. XI + 609, figs. 423).—This, the third revised edition of this book, is a manual of testing engines, pumps, refrigerating machinery, fuels, lubricants, materials of construction and the like. It contains chapters on measurement of pressure; measurement of temperature; determination of the moisture in steam; measurement of areas; engine indicators and reducing motions; measurement of power—dynamometers; flow of fluids; calorific value of fuels—solid, liquid and gas; flue-gas analysis; A.S.M.E. code on general instructions regarding power plant tests; boiler testing; steam engine testing; testing of steam turbines and turbogenerators; methods of correcting steam-turbine and engine tests; tests of complete steam power plants; gas and oil engine and producer testing; testing of ventilating fans or blowers and air compressors; testing of refrigeration plants; testing of condensers and feed water heaters; testing of hot-air engines; tests of hoists, belts, and friction wheels; testing of lubricants; tests of hydraulic machinery; testing of governors; testing the strength of materials; and outlines of suggested tests. An appendix is included.

Design and Construction of Formwork for Concrete Structures, A. E. Wynn (London: Concrete Publications, [1926], pp. XII + 296, figs. 219).—This book contains chapters on form building in general; materials, loads, pressures and stresses; theoretical design of forms; design tables; design problems; detail construction of footing forms; detail construction of column forms; wall forms; detail construction of beam and girder floor forms; forms for rib floors and structural steel fireproofing; miscellaneous forms in building construction; forms for flat slab construction; forms for conduits, sewers and culverts; forms for tanks, silos, bins and standpipes; forms for dams, piers and heavy walls; steel forms in building and wall construction; steel forms for curved surfaces; arch falsework; other bridge forms; patent devices; and planning the work.

Cool Storage of Washington Navel Oranges, G. B. Tindale (Journal, Department of Agriculture, Victoria, 25 (1927), No. 2, pp. 74-80, fig. 1).—Experiments conducted by the Department of Agriculture of Victoria, Australia, upon the effect of pre-storage treatment upon the keeping quality of Washington Navel oranges showed the advantage of careful picking and also of sweating prior to cold storage. Fruits treated in this manner kept in good condition for periods up to 3 months. The best storage temperature was around 36 deg. F. At 32-34 deg. fruits became soft and lifeless and decayed shortly after removal from the storage chambers.

The Water Requirement of Plants at Akron, Colo., H. L. Shantz and L. N. Piemeisel (Journal, Agricultural Research [U.S.], 34 (1927), No. 12, pp. 1093—1190, figs. 16).—The materials for this detailed account, which presents results of water-requirement measurements at Akron, Colo., during 1911-1917, and published in part previously, have been collected and arranged by the present authors.

The measurements dealt with a total of 288 sets of plants and more than 1,800 pots. It was possible on the basis of the average year to compare the widely different crops used in this work. The lowest values, based on total dry matter, were obtained for the millets, sorghums and corns; the highest values for the native plants, flaxes and legumes. The water-requirement range was very great, from 216 units of water for one unit of dry weight for Kursk millet to 1,131 for Franseria, a native weed. The most efficient plant was the introduced millet Kursk S.P.I. 30029, followed in order by Black Veronezh proso C. I. 15, tumbleweed, Tambov proso, Kursk millet S. P. I. 22420, Minnesota Amber sorghum, Kursk millet S. P. I. 34771, German millet, purslane, brown kaoliang, Black Veronezh S. D. 331 millet, Dakota Amber sorghum, Red Amber sorghum, Blackhull kafir, buffalo grass and Esperanza corn, all of which have a water requirement under 300. Ranges are indicated.

The range in water requirement during different years at Akron is also very great, the lowest values averaging about 60 per cent of the highest. The greatest range is for oats, for which the lowest value is 48 per cent of the highest, while the lowest range is for sorghum, for which the lowest value is 80 per cent.

Cleaning Milking Machines, R. C. Fisher and G. C. White (Connecticut Storrs Station Bulletin 144 (1927), pp. 20, figs. 6).—The cleaning and sterilizing of the rubber parts of the milking machine is the chief problem in its operation. Trials were conducted employing four methods of sterilization. The agents used were B. K. disinfectant, hot water, steam and cold running water. A total of about eight weeks was used with each method. Bacterial counts were made of the milk drawn with parts sterilized in the different manners, records were kept of the time consumed in the care of the machines, and observations were made of the effect of the various agents upon the rubber parts. After milking, cold water was drawn through each machine, and this was followed by drawing hot water through the tubes. The equipment was taken apart once a week and cleaned with a brush. The milk pails were sterilized daily with steam.

The B. K. solution at usual strength was unreliable in keeping down bacteria. Double strength solution (8 oz. to 10 gal. of water) was suitable if changed twice a week, or if a 4-oz. charge is added every other day. Hot water sterilization at 200 deg. F. for 0.5 hours gave low bacterial counts, and the damage to the rubber parts was not prohibitive in this method. Sterilizing at lower temperatures was not reliable. Steam sterilization, while effective in killing bacteria, was quite destructive to rubber. Running cold water below 55 deg. was effective, but is not reliable in summer because of the high temperature of the water. Whatever the treatment, the bacterial accumulation in the tubes may be reduced by rinsing in cold water just previous to milking and scrubbing the tubes at least twice a week.

Cotton Picking by Machinery, R. Thomas (Empire Cotton Growing Reviews, 4 (1927), No. 4, pp. 352-364, pls. 3).—An account is given of mechanical cotton picking operations as observed by the author in different countries, particularly the United States. In the last instance, the work in snapping and sledding cotton is especially described. The opinion is expressed that the time is not far distant when a large and steadily increasing percentage of the world's cotton crop will be machine made.

Investigation of a Basis for the Working Surface of the Plow [trans. title], H. von Sybel (Landw. Jahrb., 66 (1927), No. 1, pp. 1-54, figs. 10).—In a contribution from the Berlin Technical Academy an extensive theoretical consideration of the plow and its purpose is given. An analysis of the main mechanical properties of cultivated soils leads to the conclusion that a theoretical derivation of plow moldboard forms is untenable. The shaping of the working surface is therefore discussed on the basis of the conception of the plowing process as a matter of the valuation of cutting edges. Three basic plow forms are thus derived.

General information for refiners of petroleum regarding tests of lubricating oils at the Engineering Experiment Station, Annapolis, Maryland, (U. S. Department Navy, Bureau of Engineering Pamphlet NSE No. 31, rev., 1926, pp. [1] + 10).—A brief outline of tests of lubricating oils is presented.

Garden Hose Water, J. B. Marcellus (Water Works, 66 (1927), No. 12, p. 492).—Data on the flow of water through ordinary garden hose, based on 300 tests, are presented and discussed briefly.

Studies of Soil Tilth (Nebraska Station Report [1926], p. 16).—The addition of organic matter reduced the force required to shear or cut the soil, but did not reduce plow draft in one set of field plats. On the average, organic matter increased the percentage of coarse granular material as much as 50 per cent.

Soil Moisture (Nebraska Station Report [1926], p. 32).—The amount of moisture stored by summer tillage at the North Platte Substation has varied during the last twelve years from 2 to 8.5 in. per season, or from 9 to 40 per cent of the total rainfall of each season. The average was a storage at 4.87 in., or 24.8 per cent of the average seasonal rainfall.

Variation of the Transpiring Power of Leaves as Related to the Wilting of Plants, R. Koketsu (Journal, Department of Agriculture, Kyushu Imp. Univ., 1 (1926), No. 7, pp. 241-260).—Studies on the variations in the transpiring capability of plants in relation to their wilting as carried out with Coleus blumei, Triticum vulgare, and Glycine soja are detailed in their several phases. The ratio of the index of the foliar transpiring power at a definite time of the day, at which the highest value of daytime indices is most often found, to the index at night, when the transpiring power is generally low, called the "day-night ratio," was used for judging the degree of the daily fluctuation of the transpiring power. This day-night ratio, as wilting progresses, approaches unity; i.e., an equilibrium phase is attained in which the foliar transpiring power shows for a time but little variation. The value of this ratio tends to fall below unity after a time.

During the process of wilting the index of transpiring power decreases to its minimal value at the critical point of wilting, corresponding to the time of permanent wilting. It then begins to rise and the plant falls into the drying phase of low transpiration or evaporation. The same phenomenon occurs in uprooted plants. The value of the critical index seemingly tends to be practically constant for a given species whether rooted or uprooted plants be taken. Probably, however, it may be affected by such external factors as soil character. The critical indices, though approximately alike in the plants here studied, appear to be characteristic as to species individually. The soil moisture residue at the time the critical state of wilting is attained seems

not to be constant for a given soil, but to be affected more or less by the nature of the plants.

"The index of the foliar transpiring power of a plant and the soil moisture residue at the time of the critical state of wilting may be applied as the measure of the comparative xerophytism of plants, in both the lower value showing the greater drought resistance."

Storage of Seed Potatoes, J. Bushnell (Ohio Bimonthly Bulletin, 12 (1927), No. 5, pp. 142-148, figs. 3).—Investigation of methods of storing seed potatoes under farm conditions showed that during the resting stage potatoes remain dormant and firm at any ordinary storage temperature. After the termination of this stage (December or January for Russet Rurals), the storage temperature should be 41 deg. F. or lower to prevent sprouting. During winter, storage temperatures may best approximate 38 deg. Ventilation seems seldom necessary until the temperature rises to about 50 deg. in the spring. Cool storage, in which the tubers remain firm with little sprouting, appeared to be better than greening, whereas with the warmer storage came the greater wilting and sprouting and the greater advantage from greening. Similar precautions are to be observed in both cellar and pit storage.

The Loss of Water by Plants in Process of Wilting [trans. title], A. A. Nichiporovich (Zhur. Opytn. Agron. Iugo-Vostoka (Journal Experiment Landw. Sudost. Eur.-Russlands), 3 (1926), No. 1, pp. 76-92, figs. 5; Eng. abs., p. 92).—It is found that plants of diverse types show different tendencies as regards water loss. During a first period, generally speaking, a decrease in transpiration rate occurs in all cases. This decrease in xerophytes and in plants having succulent leaves is very steep. The slight decrease in mesophytes changes into a temporary increase. After this a second decrease sets in and this continues until the death of the plant. Many xerophytes dry up more slowly than do mesophytes. The presence of water tissue in plants is of significance in connection with their desiccation. Plants having much water in stems or leaves live much longer than those having little.

Cost Estimation of Irrigation Works, R. B. Van Horn (Washington [State] University, Engineering Experiment Station Bulletin 39 (1926), pp. 61, pl. 1, figs. 33).—This bulletin contains sections on status of irrigation; economic problems of irrigation; water supply and water rights; the cost report, diversion works and main canal system; the cost report, distribution system; and operation and maintenance. An appendix is included giving examples of estimating designs, tables and suggested canal structures.

The German Green Feed Silo, K. Naue (Der Deutsche Grunfuttersilo Berlin Paul Parey, 1926, pp. VIII + 166, figs. 95).—This is an extensive discussion of the historical development of silos in Germany, of the ensiling process and of the different features of silo construction. The economic significance of silos is also discussed. An extensive bibliography is included.

Weirs for Measuring Small Irrigating Streams, G. E. P. Smith (Arizona Station Timely Hints for Farmers, No. 157 (1927), pp. 11, figs. 5).—Practical information on the construction of weirs for measuring small irrigating streams is presented.

Quick Chilling and Freezing of Meat and Fish in Atomized Brine, M. T. Zarotschenzeff (Cold Storage, 30 (1927), No. 353, pp. 263, 262).—The results of experiments in the freezing of pork carcasses are tabulated.

Design of Concrete Structures, L. C. Urquhart and C. E. O'Rourke (New York and London: McGraw-Hill Book Co., 1926, 2, ed., pp. IX + 501, figs. 217).—This is the second edition of this book.

Experimental Studies of Cultivation of Certain Vegetable Crops, H. C. Thompson (New York Cornell Station Memorandum 107 (1927), pp. 73, figs. 37).—Comparative yield records taken upon vegetables growing on contrasting areas one of which was cultivated thoroughly at weekly intervals and the other simply scraped at the surface to destroy weeds indicated that weed control was the more important factor. With three species, carrots, cabbage, and tomatoes, cultivation failed to give any significant increased yield. With beets, onions, and celery the increases in favor of tillage were 4.25, 7.69, and 24.09 per cent. With the exception of celery all the crops gave larger yields in some years on the scraped areas. Observations upon an area allowed to go to weeds showed the great value of eliminating such plants. In the case of beets the destruction of the weeds increased the yields 550 per cent, as compared with 4.25 for tillage.

Moisture determinations made at frequent intervals indicated that soil mulch does not always result in moisture conservation. In 79 of 280 readings the scraped plats were ahead and in 13 cases equaled the tilled. Temperature records showed a higher average at 3, 5, and 6 in. in tilled than in scraped plats. Nitrate nitrogen determinations during the 1925 season showed a slight advantage for tillage when cultivated plats were compared with scraped fallow areas. No significant differences occurred in nitrates in planted areas except in the case of staked tomatoes, where the tilled soil averaged higher. In 12 out of 17 cases a positive relation was found between moisture content and the quantity of nitrates.

Observations upon the root systems of the several species indicated that those plants with widely extended and well-destributed roots benefit the least from tillage. Celery and onions, the plants which benefited the most from cultivation, were also least injured by cultivation, due to the narrower spread of the roots. Concluding, the author points out that cultivation is of benefit to vegetables very largely because of weed control and that deep tillage usually is not justified on account of root destruction.

The Use of Artificial Lights on White Leghorn Pullets to Increase Winter Egg Production, A. E. Tomhave and C. W. Mumford (Delaware Station Bulletin 151 (1927), pp. 15, figs. 5).—The results of three years' work are reported. Two pens of approximately 100 Single Comb White Leghorn pullets were used in each series of trials. The feeding and management were practically identical in each case except that one lot had its day lenthened by the use of artificial light in the morning. In trials 1 and 2 lights were turned on at 5 a.m., starting October 15. Each day thereafter the lights were turned on 10 minutes earlier until the lights were being turned on at 4 a.m., giving a 13 to 14-hour day. In the third trial the lights were turned on to give a 14-hour day. In trials 1 and 2 light was irradiated from a single 40-watt tungsten bulb without reflector, while in trial 3 two bulbs with reflectors were used. Mash and grain mixtures, grit, oyster shell and water were available in all tests. Sprouted oats fed in test 1 and 2 was replaced with 15 per cent alfalfa leaf meal in trial 3. All tests lasted 151 days.

The total egg production was increased 25, 14.2, and 54 per cent, respectively, in these tests. In all cases the average value per dozen for the eggs was greatest in the lighted pens, as these birds laid more eggs during peak prices. The cost of producing eggs was less when artificial illumination was used. No detrimental effects were found from the use of illumination, in fact the pullets in the lighted lot in test 3 averaged 0.3 lb. more in weight per bird at the end of the trial than those in the unlighted lot. Lights were of no value for stimulating production after March 1. Early hatched pullets subject to fall molt were safely carried over this period by the use of artificial light. The system of lighting used in test 3 was more satisfactory than in the other tests. In trial 3, 15 per cent alfalfa meal was satisfactory for replacing green feed.

Book Review

"Electro-Farming," by R. Borlase Matthews, is a new book on the application of electricity to agriculture, particularly in England. The author holds the unique position of being both an electrical engineer and a practical farmer. Much of the book is based on his farming and experimental work on his estate at East Grinstead.

Conditions on his estate are briefly explained by the author in the preface as follows: "As this is the day of specialization the farm concentrated upon the production of high grade milk, high grade pork, and high grade eggs—the 200 acres of arable land and the rest of the farm was simply worked to support the three main specialties. Experimental work is carried on quite separately from the farm routine work."

The power station, agricultural load, private plants, electric motor drives, overhead transmission systems, electro-farming in other counties, rural industries, wiring and lighting, plowing, harvesting, handling crops, threshing, ensiling, electro-culture, light treatment, irrigation and electricity in the homestead are among the subjects taken up in detail in the nineteen chapters of the book.

There are 348 text pages, 32 tables and 146 illustrations. A particularly interesting feature is the decimal classification given the chapters and the items in the index. This will prove valuable to libraries and to bibliographers who wish to classify the information given to correlate it with other writings on similar subjects. Ernest Benn, Ltd., Bouverie House, Fleet Street, London, is the publisher. The price is 25 shillings.

"The Use of Lumber on the Farm," is a well-illustrated, 38-page booklet recently published by the National Lumber Manufacturers Association. It gives information on getting the most out of lumber, including prevention of decay, prevention of termite damage, tests for dryness of lumber, painting and finishing, use in sills and posts, construction of floors, fire prevention, walls, roofs, insulation, ventilation, selection and storage of lumber and many other points.

Separate pages are given to farmstead arrangement, farm houses, barns, silos, dairy houses, hog houses, poultry houses, grain storages, sweet potato storages, stock shelters, implement shelters, garage and shop units, lawn and garden furniture, remodeling and community houses. Information is also given as to sources from which farm building plans are available.

Copies of the booklet may be secured by writing the Association at its general offices, Transportation Building, Washington, D. C.

"Farm Machinery," by Archie A. Stone, head of the department of farm mechanics, New York State Institute of Applied Agriculture, is a new textbook primarily for vocational high school courses in this subject. It will also be valuable for college courses in farm machinery and for power farmers and mechanics interested in this subject. There are two parts to the book. Part I contains chapters on plows, harrows, grain drills and seeders, corn planters, cultivators, mowers, grain binders, manure spreaders, potato planters and potato diggers, and threshing machines. Part II contains chapters on tractors, tractor carburetors, magnetos and ignition, repairing and locating tractor troubles. The problem attitude has been maintained throughout the book, the text being supplemented with shop jobs and laboratory studies. There are 285 illustrations in the 466 pages. They are largely photographs of representative farm implements and drawings of various parts of such implements. John Wiley & Sons, Inc., New York City, is the publisher. The list price of the book is $3.00.

AGRICULTURAL ENGINEERING

Established 1920

A journal devoted to the advancement of the theory and practice of engineering as applied to agriculture and of the allied arts and sciences. Published monthly by the American Society of Agricultural Engineers, under the direction of the Publications Committee.

PUBLICATIONS COMMITTEE

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The Society is not responsible for the statements and opinions contained in the papers and discussions published in this journal. They represent the views of the individuals to whom they are credited and are not binding on the Society as a whole.

Contributions of interest and value, especially on new developments in the field of agricultural engineering, are invited for publication in this journal. Its columns are open for discussions on all phases of agricultural engineering. Communications on subjects of timely interest to agricultural engineers, or comments on the contents of this journal or the activities of the Society, are also welcome.

Original articles, papers, discussions, and reports may be reprinted from this publication, provided proper credit is given.

RAYMOND OLNEY, Editor

Another Milestone

THE annual meetings of the American Society of Agricultural Engineers are looked upon as important milestones marking the advance of the profession which the Society represents. They come as a climax to the years' work in the various branches of agricultural engineering, and each year there is witnessed, as a result of the program presented, a marked advance in all branches of the profession.

The twenty-second annual meeting of the Society held in Washington last month was no exception to past events. With a registered attendance of approximately 25 per cent of its enrolled membership, with an interest and enthusiasm that is nothing short of marvelous to non-members who have had considerable contact with similar organizations, and with a spirit of good fellowship and an unselfish desire on the part of individuals to advance the general good of the profession, not only is it to be expected that the meeting would be pronounced a tremendous success, but also it is not surprising that the meeting should stand as evidence of another significant advance in agricultural engineering.

Agricultural engineers are getting the reputation, far and wide, of being an unusually hard working body of men at their professional meetings. That certainly is one of the most important reasons why such rapid progress is being made in agricultural engineering. The contacts, inspiration, new vision, technical information, etc., which agricultural engineers gain from meetings of the Society, are worth many times the investment in time and money involved. That also explains why so large a percentage of the membership attends these meetings. Also, that is what makes them the important milestones they are.

Opportunity

OPPORTUNITY has knocked—is constantly knocking—at the door of the agricultural engineering profession. It may also be said that agricultural engineers are very much alert to it, and—if the sentiment prevailing at the recent annual meeting in Washington is any criterion—they will take every advantage of the many opportunities that lie before them.

In his address before the twenty-second annual meeting of the Society, L. W. Wallace, executive secretary of American Engineering Council, stated, in outlining his conception agricultural engineers have a greater opportunity of service before them than any engineering society has had in 25 years. Leading agricultural engineers are awake to the revolutionary changes that are pending in agricultural development in this country, and a special effort will be made to formulate a program designed to make the agricultural engineer as nearly one hundred per cent effective in this development as possible.

Mr. Wallace did not say so, but he might have added that the agricultural engineers are eminently qualified for the gigantic task that lies before them.

Agricultural engineers do not take the position that they hold the solution of all agricultural problems in the hollow of their hand. They do contend, however, that they are an important factor in the solution of most agricultural problems. Not only do they stand ready to cooperate with all groups interested in agricultural development, but they insist that they be given recognition and place wherever their abilities are especially needed and where their contribution is essential to the most satisfactory working out of the problem in hand.

Who's Who This Month

LAST month on the "Who's Who in Agricultural Engineering" page, we presented the new officers and members of the Council of the American Society of Agricultural Engineers—William Boss, president; Geo. S. Knapp, first vice-president; W. C. Harrington, second vice-president, and Geo. W. Kable, councilor.

This month we present the new chairmen of the four technical divisions of the Society—L. J. Fletcher, Power and Machinery; E. A. Stewart, Rural Electric; John Swenehart, Structures, and Q. C. Ayres, Land Reclamation. All four men served as vice-chairman of their respective divisions the past year.

Our "Who's Who" page is designed to give the readers of this journal a more intimate "picture" of the men who are, at the time, taking a prominent part in Society activities and who are making outstanding contributions to the advancement of agricultural engineering. On that page are also presented recognized leaders of the profession who have in the past pioneered the development in this field and who merit the highest recognition and praise for their services. Aside from those agricultural engineers who are presented on this page, because of their connection with the Society in an official capacity, others who are presented are picked more or less at random. No attempt is made to "grade" them in accordance with any standard of eligibility for recognition.

Engineered Farming

ENGINEERED or industrialized or corporation farming, as it is variously called, is unquestionably one of the most important developments in American agriculture at the present time. It is a development in which the agricultural engineer is particularly interested, especially because it confirms his point of view with respect to the future development of farming.

He visualizes a development in agriculture not unlike that which occurred in manufacturing fifty years ago when mechanical power and labor-saving machinery began to replace hand methods. Not only does the agricultural engineer foresee a strong tendency toward larger farming units, but he can point you to many now in successful operation in various parts of the country.

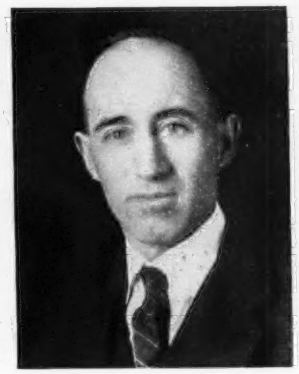
It is true that in the past corporation farming as a rule resulted in failure. It is within comparatively recent years that the combination of mechanical power, modern equipment, and managerial ability have made it possible to make a success of corporation farming.

It is interesting to note in this connection that this subject will feature the two-day meeting of the Power and Machinery Division of the American Society of Agricultural Engineers to be held in Chicago during the week of the International Livestock Exposition next December.

Who's Who in Agricultural Engineering



L. J. Fletcher



E. A. Stewart



John Swenehart



Q. C. Ayres

L. J. Fletcher

L. J. Fletcher (Mem. A.S.A.E.)—new chairman of the Power and Machinery Division of the American Society of Agricultural Engineers—is agricultural engineer and supervisor of agricultural sales of the Caterpillar Tractor Company. He is an agricultural engineering graduate of Iowa State College. Following graduation in 1915 he served one year as instructor in agricultural engineering at the State College of Washington. He then became associated with the department of agricultural engineering of the University of California where he remained eleven years—six years as head of the department. In this position, among other duties, he was chairman of the California Committee on the Relation of Electricity to Agriculture. He took up his present position January 1, 1927; this work brings him in contact with many of the larger farming projects in the United States and the application of power to ordinary types of farming in the various regions. He has served A.S.A.E. as first vice-president, and chairman of the Meetings Committee in 1926, as well as in several other important committees. He was also the first chairman of the Pacific Coast Section and played a prominent part in the organization of that section. Fletcher is generally recognized as one of America's outstanding agricultural engineers.

E. A. Stewart

E. A. Stewart (Mem. A.S.A.E.)—new chairman of the Rural Electric Division of the American Society of Agricultural Engineers—is associate professor of agricultural engineering of the University of Minnesota, in charge of the work in agricultural physics and farm utilities. He is a graduate of the University of Chicago in engineering physics. Following graduation he served four years as head of the science department in the Wichita (Kans.) High School. From 1917 to 1920 he was in charge of radio and agricultural physics at Kansas State Agricultural College. He made his present connection with the University of Minnesota in 1920, and almost immediately started a study of rural electrification in the state. He organized the first experimental rural electric line at Red Wing, Minn., in 1923, and is generally recognized as one of the outstanding pioneers in rural electrification development in this country. He has made a study of rural electrification in the Province of Ontario, Canada, and in several European countries. He has acted as consulting engineer on several heating, ventilating and sewage disposal jobs. He has served A.S.A.E. on a number of important committees, particularly in the Rural Electric and College Divisions.

John Swenehart

John Swenehart (Mem. A.S.A.E.)—new chairman of the Structures Division of the American Society of Agricultural Engineers—is professor of agricultural engineering, University of Wisconsin. He is a graduate of South Dakota State College in agricultural chemistry. On graduation he became director of the agricultural department of the state aid high school at Jordan, Minnesota. Three years later he was appointed county agricultural agent of Forest County, Wisconsin, where he served four years. In 1918 he was appointed assistant professor of agricultural engineering in charge of land clearing work at the University of Wisconsin, and was later promoted to associate professor and finally to full professor in 1923. His contribution to land clearing engineering is outstanding, and he has a nationwide reputation in this field. He has made several improvements on land clearing machinery, and was principally responsible for starting the work on the utilization of surplus war explosives for agricultural use following the World War. More recently, however, he has been devoting his energies to an intensive engineering and economic study of farm buildings. He served the Society as first vice-president, 1923-26; as chairman of the Land Reclamation Division, 1923-25; as vice-chairman of the Structures Division, 1927-28.

Q. C. Ayres

Quincy Ayres (Mem. A.S.A.E.)—new chairman of the Land Reclamation Division of the American Society of Agricultural Engineers—is associate professor of agricultural engineering, Iowa State College, specializing in stream measurement and control, flood protection, land drainage, and irrigation. He is a graduate in civil engineering of the University of Mississippi. He was assistant professor of civil engineering at that institution prior to accepting his present position in 1920. In professional practice he has been engaged in sewer design and construction; design and construction of drainage canals in the Mississippi delta; highway construction; surveys and plans for Muscle Shoals project, etc. During the World War he served as second lieutenant with the First Engineers (First Division) on the Toul front, with the Second Engineers (Second Division) in the Argonne and with the army of occupation at Coblenz, and he also trained engineer replacements with the 116th Engineers. He returned to the United States in June, 1919, as first lieutenant. In his present position he conducted a research study in engineering education, involving analysis and interpretation of 70,000 replies to questions from engineering students and alumni of Iowa State College. He has served the Society as vice-chairman of the Land Reclamation Division (1927-28) and on a number of committees.

John J. Glessner Elected an Honorary Member

AN IMPORTANT phase of agricultural engineering history was recently given worthy and timely recognition by the American Society of Agricultural Engineers when it elected John J. Glessner to honorary membership.

Mr. Glessner, at present a director of International Harvester Company, is richly entitled to this honor. His active service in the farm implement industry extends over the extraordinary period of sixty-five years, for nearly sixty of which he has been an executive and principal in the direction of large affairs having to do with the design, manufacture, and marketing of agricultural machinery. Still active at eighty-five, he is the proud possessor of a service record longer than that of any past or present implement man anywhere, so far as known.

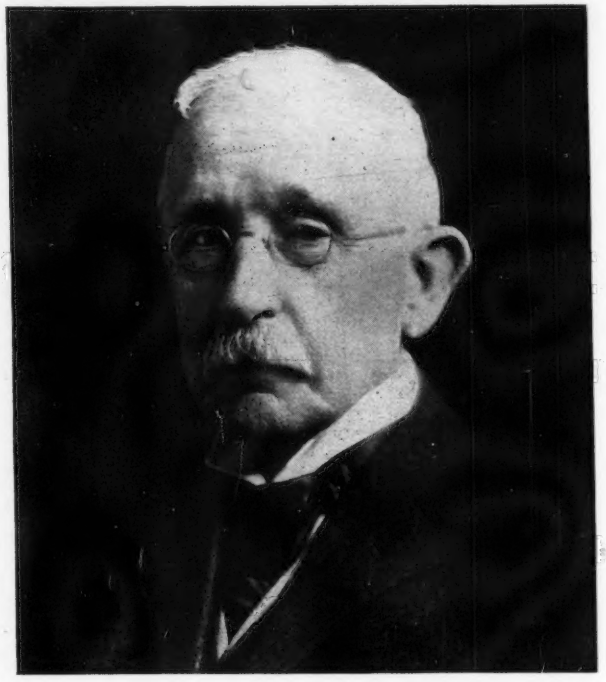
For the Society's honor roll Mr. Glessner typifies the group of able, aggressive pioneering executives of the implement companies of the early days. Then they were leaders when agriculture was conquering the west, essentially aided by the concurrent development of the self-binder. And now, when all others of these leaders have passed on, Mr. Glessner remains, a living witness of and participant in that great foundation period.

In those four or five decades preceding the formal organization of the American Society of Agricultural Engineers, a host of inventions were shaped into labor-saving farm equipment and comprise the prior art which today influences and gives direction to design and manufacture. It was in this colorful period of phenomenal inventive development that Mr. Glessner was a leader. In recognition of its debt to this phase of agricultural engineering fundamentals the Society pays tribute to him.

In all his long career, Mr. Glessner has been associated with but one concern and its successors. He began in 1863 in the office of Warder and Childs, Springfield, Ohio, who manufactured principally a combined hand rake reaper, plow, and cotton seed planter, a year or two later adding a self-raking reaper. At that time this reaper embodied the very latest thought in a practical harvesting machine.

With a change in the personnel of the firm of 1866, Mr. Glessner was taken into partnership, the new name being Warder, Mitchell and Company. In 1869, as he continued to advance in the confidence of the major stockholders of the company, he was sent to Chicago to take charge of the territory west of that city. In this same year manufacture under royalty of the famous Marsh harvester was begun. In 1887 Warder, Bushnell and Glessner succeeded to the business, with Mr. Glessner as vice-president. Coincident with this, rights to the Champion line of binders, mowers and rakes were purchased from Wm. N. Whitely, a leading manufacturer of that day and popularly called the "Reaper King." The new concern was very successful in keeping its product up to date and gradually grew, as the years went by, until, in 1902, it was one of three leading agricultural implement firms of the country. In that year the company became a part of International Harvester Company. On this occasion Mr. Glessner was elected chairman of the executive committee in which capacity he served for a short time. At the same time he was elected a vice-president. He served as vice-president until 1919, when he decided to withdraw from the operating side of the business. As he had been a director since 1902, he has continued in this capacity to be an important figure in the management of the company's affairs. His counsel, ripe experience and broad perspective of the industry are constantly drawn upon by his associates in the administration of the business.

Active as Mr. Glessner has been in the direction of large affairs, he has had time to cultivate and indulge his love of civic, artistic, and other cultural movements, and he has heartily contributed his influence in attainment of their objectives. An indication of his earnestness in this regard is found in the number and character of his civic and community affiliations. He is a trustee of the Chicago Orphan Asylum, Rush Medical College (now the medical department of the University of Chicago), Chicago Orchestral Association, and the Art Institute of Chicago. He is a member and former president of the Commercial Club of Chicago, and is also a member of the Chicago Union League, Quadrangle, Literary and Caxton Clubs, and the Architects' Club of Chicago. He was president of the Citizens' Association of Chicago during the period when that organization prepared the bill for establishing the Sanitary District of Chicago and secured its passage through the legislature of Illinois; and from the initiative efforts in which Mr. Glessner had so important a share has resulted the Chicago Drainage Canal, the greatest engineering work ever undertaken by a city for the purposes of sanitation. He is also an honorary member of the American Institute of Architects and of the Harvester Choral Society, an organization of International Harvester employees interested in music.



John J. Glessner

Despite the great length of his active business life, Mr. Glessner is at one with the younger generation as an earnest student of and believer in the possibilities of today. As he stated in reminiscences published not long ago, "The moral of it all, if there be a moral in looking backward, is that hard work, steady application, good judgment, and indomitable perseverance bring success, the same as in any other reputable calling. The past is past; it is now that counts—the present and the time to come. We must take the conditions that we have today; make the most of them if they are in our favor, and overcome them if they are against us. That was the time of small things and individual efforts; this is the day of great things, and not only must each of us in any organization do his individual best in whatever position he is placed, but that best must supplement the work of every other man."

A. S. A. E. and Related Activities

The Washington Meeting

ENTHUSIASM characterized the 22nd annual meeting of the American Society of Agricultural Engineers, at Washington, D. C., from the time members began arriving on Sunday, June 17, until the last meeting adjourned Friday night. During that time agricultural engineers, with their wives and families, practically took over the Hamilton Hotel by force of numbers.

At 10 o'clock Monday morning the rural electric project leaders were called to order by their chairman, E. W. Lehmann, of the University of Illinois. They discussed desirable nomenclature and standard practices to be followed in their work, and each of the leaders reported on the nature and status of work being done on their projects.

Tuesday morning officially opened the meeting proper with simultaneous sessions of the resident workers and the extension workers of the College Division.

On the resident workers program a paper by Q. C. Ayres, agricultural engineer, Iowa State College, entitled "Trends in Professional Agricultural Engineering Education," was read by F. C. Fenton, Mr. Ayres being unavoidably absent. A paper, entitled "Student Relations of the Agricultural Engineering Profession as a Factor in its Advancement," by Ralph A. Palmer, assistant secretary of the American Society of Agricultural Engineers, was discussed by S. P. Lyle, agricultural engineer, University of Georgia, and by Chairman H. B. Walker. "The Confessor—the House Organ of Agricultural Engineering Education," a paper by E. R. Jones, University of Wisconsin, was read by John Swenehart of the same institution. Committee reports presented during the balance of the session were as follows:

1. Farm Mechanics in Secondary Schools—B. B. Robb
2. Cooperative Relations—J. B. Davidson
3. Farm Machinery Instructions—A. J. Schwantes

The agricultural engineering extension workers at their session, in addition to papers, entitled "How to Teach the Adult," by A. B. Graham, chief of the division of subject matter specialist of the U.S.D.A. Office of Cooperative Extension Work, and one entitled "A Formula for Effective Extension Teaching," by H. B. Hochbaum, agriculturist of the Department of Agriculture, listened with a great deal of interest to the report of the Committee on Agricultural Engineering Extension presented by L. A. Jones, of the U.S.D.A. Division of Agricultural Engineering, and a member of the Committee. This was one of the livest sessions of the entire meeting.

Two addresses featured the afternoon session of the College Division. "The Effect of Industrial Progress on Educational Methods in Land Grant Colleges," was the title of an address by Dr. R. A. Pearson, president, University of Maryland. Dr. Harrison E. Howe, editor, "Industrial and Engineering Chemistry," spoke on "The Development of Research Programs and Research Workers." Following these addresses the College Division held a short business meeting.

Later in the afternoon a fleet of busses took all who wished to go on a sight-seeing trip about Washington and across the Potomac River to Arlington National Cemetery.

The land clearing group, the consulting agricultural engineers and the student members of the Society each held group meetings Tuesday evening to discuss matters of special interest to them.

General sessions were held Wednesday morning and afternoon in the auditorium of the Department of the Interior building with Col. O. B. Zimmerman, president of the Society, presiding. S. H. McCrory, chairman of the Meetings Committee, called the meeting to order.

"The Ascendency of Applied Science in Agriculture," was the title of the President's annual address by Col. O. B. Zimmerman. Dr. Elwood Mead was unfortunately called out of Washington and his paper on "The Jewish Land Settlements in Palestine," was read by the acting director of the Bureau of Reclamation. Slides were shown in connection with this paper, illustrating some of the settlements and also agricultural conditions in Palestine. In a paper, entitled "Agricultural Engineering in Europe," Dr. Hermann Schildknecht, agricultural engineer for the Republic of Switzerland, called attention to outstanding agricultural engineering problems in Europe and work which is being done there.

Before the morning session adjourned Dr. Milton Fairchild told the audience briefly of the interesting work being done by the Character Education Institution. A particularly valuable folder outlining the scientific method of thinking, the characteristics of the scientist, how research on human beings is conducted and the "Intellectual Immoralities" is available on request to the Character Education Institution, Chevy Chase, Washington, D. C.

Papers and addresses on the afternoon program were: "Economic Research on Cotton Production," by Dr. Bonney Youngblood, U.S.D.A.; "Rural Sanitation," by Dr. L. L. Lumsden, senior surgeon, U. S. Public Health Service; "Extension Methods in Agriculture," by Dr. C. W. Warburton, director of extension work, U. S. Department of Agriculture, and "A Standard Method of Making of Time and Loss Studies," by H. H. Musselman, professor of agricultural engineering, Michigan State College.

A three-hour business meeting occupied the attention of members on Wednesday evening, in which reports were pre-



Some of the agricultural engineers who were present at the Washington meeting

sented by the Secretary-Treasurer, Finance Committee, Publications Committee, Consulting Engineers Division, Committee on Bureau of Agricultural Engineering, Research Committee, Committee on Farm Appraisal Methods, and Society representatives on American Engineering Council, Committee on the Relation of Electricity to Agriculture, the Advisory Council of the Federal Board of Survey Maps. Reports were also received from four of the geographical sections.

A memorial service commemorating E. R. Wiggins and J. T. Stewart, members of the Society who passed away during the previous Society year was held at this session.

The latter part of the business meeting was given over to a general discussion of the desirability of setting up a program for the agricultural engineering profession, as a means not only in analyzing present status of the profession and the Society's relation to it, but also to paint a picture of the probable future development of agricultural engineering, the direction it is taking, and the angles in this development that should be given particular emphasis.

Thursday was the big day of the program. The four technical divisions—Power and Machinery, Rural Electric, Structures and Land Reclamation—held simultaneous sessions during the morning and part of the afternoon.

At 2:45 p.m. all sessions adjourned to give every one attending the meeting the opportunity to visit the Commerce Building and hear the Secretary of Commerce, Herbert Hoover, who spoke briefly to the group at 3 o'clock.

Texas phrynosoma cornutum was the center of attraction at the annual banquet Thursday evening. Though suspicious at first, the guests were soon won over by the quiet, unassuming, self-effacing manner of this little animal. They are looking forward to renewing their acquaintance with him at the meeting in Dallas next year. In his home state, Texas phrynosoma cornutum is commonly known as the "horned toad."

"Chief engineer" of the occasion, William Aitkenhead, head of the department of agricultural engineering, Purdue University, governed the program for the greatest pleasure of all. Dr. A. F. Woods, director of research, U.S.D.A., and William Butterworth, president of the U. S. Chamber of Commerce, gave the addresses of the evening. Between their addresses Miss Mary Russel Williams sang two solos. Following the banquet the floor was cleared for dancing.

At the general session Friday morning Dr. I. O. Schaub, Dean, North Carolina State College of Agriculture, presented a paper on "Land Development." L. W. Wallace, executive secretary, American Engineering Council, explained the function of that organization and told of some of its activities, particularly in promoting the interests of agricultural engineers. K. J. T. Ekblaw, vice-president, Frank B. White Company, presented a paper on "Advertising as it Relates to Agricultural Engineering." Dr. D. B. Lucas, chairman of the Committee on Duty of Cultivating Equipment, presented a report of the committee at this time. A. W. Farrall, chairman of the Committee on Dairy Equipment, presented an interesting report for his committee.

Friday afternoon two trips were offered. One could go either to the Bureau of Standards or to Mount Vernon.

Special entertainment for the ladies included trips to the Capitol, White House, Treasury Building, Red Cross Building, Continental Hall, Pan-American Building, the Washington Monument and a number of museums. On Wednesday afternoon they had a reception tendered them by Mrs. Herbert Hoover at her home. Wednesday evening they attended a concert by the Marine Band.

A.S.M.E. and A.S.A.E. to Hold Joint Session

THE American Society of Agricultural Engineers has accepted an invitation from the American Society of Mechanical Engineers to join them in putting on a joint session on "Power in Agriculture" as a feature of the annual regional meeting of the latter organization to be held in St. Paul, August 27 to 30, 1928. The meeting will take on a national significance by reason of the official attendance of the council of the American Society of Mechanical Engineers.

"Resources of the Northwest" will be the keynote of the meeting. Agricultural engineers will present the agricultural phase of the program.

William Boss, president of the American Society of Agricultural Engineers, and chief of the division of agricultural engineering, University of Minnesota, will preside at the "Power in Agriculture" session on Tuesday morning, August 28. E. A. Stewart, division of agricultural engineering, University of Minnesota, and chairman of the Rural Electric Division of this Society, will present a paper which will be discussed by Arnold P. Yerkes of the International Harvester Company. L. J. Fletcher, of the Caterpillar Tractor Company, and chairman of the Power and Machinery Division of this Society, will present a paper to be discussed by E. M. Mervine, agricultural engineer, Iowa State College.

Thomas D. Campbell, president, Campbell Farming Corporation, will be the principal speaker at the dinner meeting on Wednesday evening, August 29.

Members of the American Society of Agricultural Engineers are cordially invited to attend all of the technical sessions and social events of the meeting.

Power Take-Off Standards Revised

THE American Society of Agricultural Engineers announces that final approval by the membership of the Society of a revision of A.S.A.E. Standards for Power Take-Off for Farm Tractors. Copies of these standards are available to non-members of the Society at five cents each.

Personals of A.S.A.E. Members

W. T. Ackerman, electrical project director and engineer, New England Rural Electrification Project, New Hampshire Agricultural Experiment Station, is author of Bulletin No. 233, entitled "Electric Dairy Cold Storage," just issued by that station.

Q. C. Ayres, associate professor of agricultural engineering, Iowa State College, is author of Bulletin No. 86, entitled "A Study of Engineering Education at Iowa State College Based on Facts and Opinions of Students and Alumni," recently published by the engineering experiment station of that institution.

I. P. Blauser recently resigned as farm mechanics instructor at the University of Illinois to accept an appointment as secretary and field engineer for the Ohio project on the Relation of Electricity to Agriculture. His new address is department of agricultural engineering, Ohio State University, Columbus.

E. D. Gordon has been appointed assistant agricultural engineer in farm fire prevention work in the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, Washington.

W. D. Hemker has severed his connection with the general engineering department of Westinghouse Electric & Manufacturing Company to become associated with the farm machinery department of Pennsylvania State College, State College, Pa. He will be engaged in rural electrification research work, giving special attention to the design and development of applications of electricity to agricultural machinery and operations.

H. S. Hinrichs has resigned as agricultural engineer, Kansas State Agricultural College, to become rural service engineer of the Kansas Power and Light Company, Topeka.

Dr. Georg Kuehne, professor of agricultural engineering, Technical Academy of the State of Bavaria, Munich, Germany, is author of "Handbuch der Landmaschinentechnik," Vol. 1, No. 1, compiled by Julius Springer of Berlin.

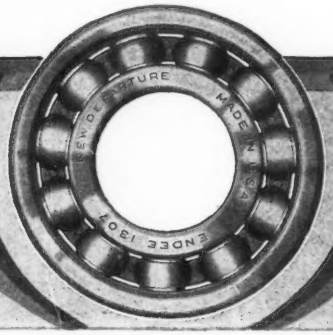
E. W. Lehmann and **R. C. Kelleher,** chief in farm mechanics and formerly first assistant in farm mechanics, respectively, are joint authors with A. M. Buckwell, chief of the Illinois State Water Survey, of Bulletin No. 304, entitled "A Study of Factors Affecting the Efficiency and Design of Farm Septic Tanks," a joint publication by the Illinois Agricultural Experiment Station and the Illinois State Water Survey.



New Departures Prolong Life of Rock Island Tractors

THE life of a tractor depends largely upon how well the bearings maintain the efficient alignment of shafts and gears, without readjustment, in the hands of the farmer. ¶ Rock Island Plow engineers have kept this consideration foremost in selecting New Departure Ball Bearings. ¶ Just as "nothing rolls like a ball," so no other type bearing can equal New Departure for allowing the transmission of engine power to drawbar with minimum of frictional loss.

THE NEW DEPARTURE MANUFACTURING COMPANY
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New Departure Quality Ball Bearings

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Roy N. Towl, of Towl, Nelson & Schwartz Consulting Engineers, Omaha, Nebraska, under the title "Behavior of Rivers," has prepared a brief outline of his several years of close up study of river problems, which consists of preliminary notes concerning natural tendencies of the Missouri and Mississippi Rivers.

Hubert D. White has resigned as general sales manager of the Continental Manufacturing Company, Springfield, Ohio, to accept an appointment as vice-president and general manager of the Frank B. White Company, advertising agency, 33 South Clark Street, Chicago, Illinois.

New A.S.A.E. Members

Robert C. Burnette, extension instructor in rural engineering, Cornell University, Ithaca, N. Y.

Jehan d'Etigny, manager, Compania Agricola de Vallenar, Vallenar, Chile.

Clyde R. Higgins, assistant to general agent, California-Oregon Power Company, Medford, Ore.

Eugene N. Gatlin, rural service specialist, Texas Power & Light Co., Dallas, Tex.

Thomas A. Goodridge, manager, agricultural division, Crucible Steel Company of America, Chicago, Ill.

Albert M. Jongeneel, ranch superintendent, Alaska Packers Association, San Francisco, Calif.

Herbert F. Reinhard, chief engineer, J. B. Colt Company, New York, N. Y.

J. P. Schaenzer, rural electrification specialist, University of Wisconsin, Madison, Wis.

Ralph G. Wadsworth, civil engineer, Fred H. Tibbets, 1320 Alaska Commercial Bldg., San Francisco, Calif.

Transfer of Grade

Truman E. Hienton, associate in agricultural engineering, Purdue University, Lafayette, Ind. (Associate Member to Member.)

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the June issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Edward B. Archbald, farm manager, Archbald and Co., Waterport, N. Y.

C. W. Drake, general industrial engineer, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

O. E. Eggen, chief engineer, Hart-Parr Co., Charles City, Iowa.

Bert S. Gittins, assistant, research department, National Association of Farm Equipment Manufacturers, Chicago, Ill.

Francis W. Holden, irrigation engineer, Hempstead, Long Island, N. Y.

Frank Irons, development agricultural engineer, European Corn Borer Control, U. S. Dept. of Agriculture, Toledo, Ohio.

David A. Isler, development agricultural engineer, European Corn Borer Control, U. S. Dept. of Agriculture, Toledo, Ohio.

Carlton W. Jones, consulting engineer, Towson, Md.

Arnold W. Perry, farmer, "Boorawa," Tarana, N.S.W., Australia.

Russel H. Reed, Dickinson, N. D.

John W. Savage, special promotion, General Electric Co., Bridgeport, Conn.

F. F. Wetmore, drainage engineer, Lumberton, N. C.

Lewis T. Wood, agricultural engineer, Virginia Electric and Power Co., Richmond, Virginia.

Transfer of Grade

R. H. Driftmier, associate professor of agricultural engineering, Kansas State Agricultural College, Manhattan, Kan. (Associate Member to Member)

Robert A. Norton, assistant drainage engineer, Division of Agricultural Engineering, Bureau of Public Roads, Washington, D. C. (Junior to Associate Member)

Employment Bulletin

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Nonmembers as well as members, are privileged to use the "Positions Open" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER available. Seventeen years experience in the designing and manufacture of farm tractors, motor trucks, harvesting machines, and earth-working tools. Sales experience in United States, Canada, England, France, and Italy. Write for interview. MA-132.

AGRICULTURAL ENGINEER desires position with barn equipment manufacturing company. Graduate in agricultural engineering from Iowa State College. Has had farm experience and considerable experience in designing and drafting of farm structures. Services available on thirty days notice. MA-149.

AGRICULTURAL ENGINEER, graduate in agricultural engineering, (B.S. in 1923; M.S. in 1924) desires position in experimental research work. Two years experiment station experience, five years industrial shop experience, eighteen months in employ of electric service company, one year teaching. Available upon reasonable notice. Age 27. Married. MA-142.

DESIGNING AND RESEARCH ENGINEER with experience in developing equipment and machinery for commercial field. Several years experience in commercial research. Will undertake specific projects for business desiring the solution of problems in design, performance testing, or engineering analysis. MA-145.

EDITOR AND WRITER with ten years experience in farm mechanical equipment, from both trade journal and farm paper angles, specializing on promotion and technique of power farming. Qualified for publication, house organ, advertising literature, or sales promotion work involving technical accuracy and popular appeal. Farm background, college training, instructional experience. W. B. Jones, St. Joseph, Mich.

AGRICULTURAL ENGINEER desires position as general manager of large agricultural concern where initiative, ability and resourcefulness are required. Has knowledge of legal procedure and finance, has handled agricultural propositions employing three thousand men, speaks Spanish, recently carried out reorganization in Latin America for one of the largest banks in this country. Can furnish credentials as to character, integrity and sobriety. 40 years of age, excellent health, American native born, protestant, married. Will go anywhere but prefers continental U.S.A. MA-148.

MECHANICAL AND AGRICULTURAL ENGINEER, graduate of University of Michigan, with many years experience in the design, purchasing, production, manufacture, and sale of agricultural implements, iron pumps, hand and power spray machinery, and with a wide acquaintance with manufacturers, jobbers, and dealers, desires employment with a reliable and substantial manufacturer. Will go anywhere. MA-150.

MECHANICAL ENGINEER, graduate of a New England college, with twelve years commercial drafting experience, six years in college teaching, desires position in college work. Forty-two years of age; unmarried; naturalized citizen of English birth; Protestant. Available August 1. MA-151.

AGRICULTURAL ENGINEER desires a position as an irrigation engineer or as an agricultural engineering extension agent. Graduate in agricultural engineering from the University of Nebraska. Has had farm experience and experience in the field of pump irrigation. Available after September 10. M.A. 153.

Positions Open

AGRICULTURAL ENGINEER with college training and practical experience with tillage tools and seeding machinery wanted by a farm machinery manufacturer in the Middle West. Must be skilled draftsman and have designing ability. PO-132.

AGRICULTURAL ENGINEER capable of designing automatic shocking machine for commercial production from a factory model that has been successfully demonstrated in the field for four years wanted at once. Wire A. L. Marks, 407 Empire Block, Edmonton, Alberta, Canada, giving full particulars as to training, experience, references, and salary expected.

THREE ENGINEERS with several years experience in tractor design wanted by old established tractor manufacturer. Interested persons should explain experience fully, salary expected, etc. PO-134.